Looking west from stock pond MSP017 on Enoch Valley waste rock dump MWD091

P4 PRODUCTION

2007 AND 2008 DATA SUMMARY REPORT
MINES SITE INVESTIGATION

FINAL
Revision 2

Prepared by

MWH

2353 130th Avenue N.E., Suite 200
Bellevue, Washington 98005

August 2009

August 18, 2009

Mr. Mike Rowe
IDEQ
444 Hospital Way, #300
Pocatello, ID 83201

RE: Submittal of *2007/2008 Data Summary Report - Final Revision 2*

Dear Mike,

Please find enclosed the final 2007/2008 Data Summary Report. This revision is in response to comments provided to P4 Production by the Agencies and Tribes (A/T) on June 12, 2009 that also provides condition approval. The final approval was conditional based on incorporation of comments contained in the June 12 letter and an addendum requested by the A/T in a May 12, 2009 e-mail. This addendum has been approved by the A/T and is included in the Data Summary Report.

The responses to the A/T comments are included Appendix G of the document along will all previous comments and responses. The requested addendum is contained in Appendix F along with an ASTM document that was requested in the last set of A/T comments. The substantive changes to the document text have been underlined. Changes to tables, figures and drawings have not been highlighted.

The document is being submitted electronically via ftp site, and in hard copy.

If you have any further questions about this submittal, please do not hesitate to contact Barry Koch or me.

Best Regards,

Cary Foulk

Cary L. Foulk
Supervising Geologist/Geochemist

Enclosure – Revision 2 of the 2007/2008 Data Summary Report.

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2007 AND 2008 DATA SUMMARY REPORT

MINES SITE INVESTIGATION

FINAL
Revision 2

AUGUST 18, 2009

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ACRONYMS AND ABBREVIATIONS

AOC	Administrative Order of Consent
AMSL	Above Mean Sea Level
A/T	Agencies and Tribes
bgs	Below Ground Surface
bmp	Below Measuring Point
CADD	Computer Aided Drafting Design
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	Centimeter
COPC	Contaminant of Potential Concern
cu. yd.	Cubic Yards
DEM	Digital Elevation Model
DSR	Data Summary Report
ft	Feet
ft-AMSL	Feet Above Mean Sea Level
FSP	Field Sampling Plan
GIS	Geographic Information System
gpm	Gallons per Minute
GPS	Global Positioning System
e.g.	*exempli gratia* (Latin, for example)
EE/CA	Engineering Evaluation/Cost Analysis
EPA	(U.S.) Environmental Protection Agency
i.e.	*id est* (Latin, that is to say; in other words)
IDEQ	Idaho Department of Environmental Quality
IDWR	Idaho Department of Water Resources
MCL	Maximum Contaminant Level, Federal Drinking Water Standard
mcy	Million Cubic Yards
MDL	Method Detection Limit
mg/L	Milligram per Liter
MWH	MWH, Inc. (formerly Montgomery Watson Harza, Inc.)
MP	Measuring Point
ORP	Oxidation/Reduction Potential
P4	P4 Production L.L.C.
PMA	Pneumatic Manifold Assembly
PVC	Polyvinylchloride (plastic)
QC	Quality Control
sec	Second
SEGW	Surface Expression of Groundwater
SI	Site Investigation
SOP	Standard Operating Procedure
sq. ft.	Square Feet

1.0 INTRODUCTION

This Data Summary Report (DSR) is being submitted as a deliverable for work under the Consent Order/Administrative Order on Consent for the Performance of Site Investigations and Engineering Evaluations/Cost Analysis (EE/CAs) at P4 Production, L.L.C. Phosphate Mine Sites in Southeastern Idaho (08/20/03), EPA Docket No. CERCLA-10-2003-0117. This document will specifically support the Site Investigation (SI) and the data presented herein will be incorporated into the SI Report when it is produced.

This DSR documents the results of the Phase IIb Groundwater Investigation and the results of the 2007 and 2008 surface water sampling conducted at the P4 Production, LLC (P4) Ballard, Henry and Enoch Valley Mines (Drawing 1). In addition, several other minor activities, completed in 2008 to address identified data gaps are reported. This includes further evaluation and refinement of mine waste rock pile and pit boundaries, including significant mass wasting features, evaluation of the site water balance, and a water typing analysis.

The DSR fulfills the obligations made to the Agencies and Tribes (A/T) for reporting data collection at Ballard, Henry, and Enoch Valley Mines during the 2008 (and 2007 as appropriate) field season. The report is concise and provides more voluminous details as technical memoranda in appendices. The data presentation focuses on addressing previously identified data gaps. Conceptual models previously presented in MWH (2008c) will not be presented again except where related to a specific data gap being addressed or where a significant revision has occurred.

1.1 Report Description and Project Objectives

This report is intended to fulfill the requirements for reporting data consistent with a CERCLA SI or Remedial Investigation. Consistent with this approach, after completing each annual field season's sampling and analysis, a concise site characterization DSR is prepared. This DSR reviews the investigative activities that have taken place during the field season and describes and displays site data to document the location and characteristics of surface and subsurface features and contamination at the site, including the affected media, locations, types, physical state, concentrations and quantities of contaminants. The DSR also evaluates data gaps and identifies additional and/or modified sampling and analysis that shall be included in modifications to the work plans for the subsequent field season. The content of this DSR is as follows:

Section 1 – Introduction

Section 2 – Data from 2007 and 2008 Investigation Activities

Section 3 – Updated Data Gap Evaluation

Section 4 - Conclusions

Section 5 – References

Because this document is intended to be a summary document, details and complete data reporting related to the more extensive field activities are contained in appendices. This includes the details of the direct-push sampling program and the surface water sampling program.

The basis for surface water monitoring conducted in 2007 and 2008, and reported herein, was the *2007 & 2008 Surface Water Monitoring Plans - Final* (MWH, 2007a). The program was a continuation of the surface water characterization conducted under the 2004 AOC, and regionally since the late 1990's. The continuation of this program was specifically requested by the IDEQ in February 2007. Complete rationale and objectives for the program are provided in the monitoring plans (MWH, 2007a).

The basis for the groundwater work conducted in 2008 is the *Final – 2008 Phase IIb Monitoring Well Installation Technical Memorandum* (MWH, 2008a), and the *Direct-Push Groundwater Sampling Work Plan, Enoch Valley, Henry and Ballard Mines* (MWH, 2008b), which were presented in fulfillment of Activity 3b-5 of the *Final 2005 Phase II Supplemental SI Groundwater Work Plan* (MWH, 2005) (phase II groundwater work plan). The phase II groundwater work plan is an addendum to the *P4 Production Southeast Idaho Mine-Specific Selenium Program 2004 Comprehensive Site Investigation Final Work Plans for Ballard, Henry and Enoch Valley Mines* (MWH, 2004) (2004 SI Work Plans). In addition, results reported in this DSR address data gaps and actions agreed to by the A/T and P4 as the result of field work and analysis presented in the *Conditional Final - 2007 Hydrogeologic Data Collection Activities and Updated Conceptual Models - Interim Report for Hydrogeologic Investigation* (the Interim Groundwater Report; MWH, 2008c).

The overall purpose of the groundwater investigation is to identify groundwater flow systems that are contaminated by waste rock sources at the P4 mines, and to characterize the nature and extent of such contamination and ultimately the risk associated with it. This groundwater investigation has been conducted in a phased approach, such that initial phases of work focused on information gathering and development of site hydrogeologic conceptual models. Phase I work included gathering easily accessible chemical data from the sampling of seeps, springs, and existing groundwater wells to identify specific areas of interest and areas in need of further investigation. The results of the Phase I work and the initial Phase II groundwater monitoring well installation program were reported in the Interim Groundwater Report (MWH, 2008c). The Phase II program is focused on collecting new data to specifically characterize groundwater flowpaths and potential impacts associated with the mine areas. Monitoring wells for the Phase II program were installed in 2007 and 2008. This report specifically presents results from the 2008 well installation and direct-push sampling programs (MWH, 2008a and b). The objective of these programs was to address data gaps presented in the Interim Groundwater Report (MWH, 2008c).

1.2 Data Gaps Addressed

As noted in the preceding section, the major objective of the 2008 groundwater program, consisting of new well installation and a direct-push sampling program, was to address data gaps identified in 2007 from review of the data collected to that point and evaluation of the conceptual models. The following Table 1-1, *Data Gap Action Summary*, summarizes the data gaps identified in 2007 and the associated actions and outcomes. Complete analysis of the data gaps, including identification of any remaining data gaps, and findings is provided in Section 3 of this report.

Additional data gaps that were addressed by tasks reported in this DSR include:

- Improved mapping including mass wasting survey information and dump and pit areas and volumes (waste rock pile boundaries adjusted appropriately)
- Water balance assessment
- General water quality typing evaluation

TABLE 1-1
DATA GAP ACTION SUMMARY

Mine Area	Data Gap	Proposed Action to Address Data Gap	Action(s) Completed	Significant Findings
Ballard – Eastern Mine Area	Extent of impacts in the alluvial system east of the Ballard Mine waste rock dumps is not well understood.	Direct-push program utilizing selenium as an indicator of impacts to groundwater.	25 direct-push borings were advanced, 18 direct-push groundwater samples collected, seven locations were dry. Two direct-push alluvial wells installed.	A groundwater plume was identified with elevated selenium concentrations.
	Possible impacts to the Dinwoody Formation resulting from impacted alluvium have not been identified.	Monitoring well MMW029 to be installed in an area of impacted alluvial groundwater as identified from the direct-push program.	Monitoring well MMW029 was successfully installed and sampled.	A total selenium concentration of 0.81 mg/L was measured in the fall of 2008.
	Potentiometric data; impacted groundwater flow in the alluvium could cross the trace of the Slug Valley Fault east of the mine area and infiltrate into the underlying Wells Formation.	Direct-push wells installed on opposite sides of Slug Valley Fault.	Direct-push monitoring wells were installed so alluvial water levels could be observed.	Appears to be a gradient toward the assumed trace of the Slug Valley Fault.
Ballard – Western Mine Area	Extent of impacts in the alluvial system west and southwest of the Ballard Mine waste rock dumps is not well understood	Direct-push program utilizing selenium as an indicator of impacts to groundwater.	44 direct-push borings were advanced, 37 direct-push groundwater samples were collected, six locations were dry. Seven direct-push alluvial wells installed.	A groundwater plume was identified with elevated selenium concentrations.
	Impacts to Wells Fm. are possible due to alluvium impacted from waste rock	Direct-push program utilized to characterize extent of alluvial impacts,	Monitoring well MMW030 installed in impacted alluvial area; MMW031 also installed	Elevated concentrations of selenium were not located in the Wells Formation in the

TABLE 1-1 DATA GAP ACTION SUMMARY				
Mine Area	**Data Gap**	**Proposed Action to Address Data Gap**	**Action(s) Completed**	**Significant Findings**
	seepage. Groundwater quality and potentiometric data are needed.	monitoring wells installed into Wells Formation in areas of known or probable alluvial impacts.	in Wells Formation at toe of waste rock dump MWD081.	areas investigated
	It is also possible that some structures (e.g., along the south edge of the mine area) could result in impacted groundwater flow to the Wells Formation.	Monitoring well installed near the inferred trace of the major fault bounding the south side of the Ballard mine area.	Monitoring well MMW030 installed to address this data gap as well as the previous data gap.	The Wells Formation was not found to contain elevated selenium in this area.
Ballard – Central Mine Area	General discharge is to interior mine areas; however, some flow to the drainage south of MMP035 is possible. Geology would direct this flow either to the alluvial system or Wells Formation.	Direct-push program utilizing selenium as an indicator of impacts to groundwater in probable alluvial flowpath, and a monitoring well was to be installed in the probable bedrock flowpath.	Six direct-push groundwater samples were collected in the downgradient drainage area (included in overall western area above) and monitoring well MMW030 is in the probable bedrock flowpath.	The alluvium in the area of interest did not contain groundwater. Elevated selenium concentrations were identified in the alluvium further downgradient but appear to be associated with MWD081.
Henry Mine	Extent of impacts to shallow alluvium not well understood on the NE portion of the Henry Mine east of MMP041.	Direct-push program utilizing selenium as an indicator of impacts to groundwater.	Seven direct-push groundwater samples were advanced, two locations were sampled, five were dry and bedrock was encountered before groundwater was located.	An alluvial system not present in northern portion of the Henry Mine. All boreholes were dry or had bedrock refusal before groundwater was encountered.
	Alluvial groundwater has not been sampled below the toe of Valley fill portion of MWD087 in the Long Valley drainage.	Direct-push program utilizing selenium as an indicator of impacts to groundwater.	One direct-push borehole was advanced at toe of waste rock. The borehole was dry.	Alluvial groundwater was not present.
	Alluvial groundwater data from small drainage on south end	Direct-push program utilizing selenium as an	Two direct-push boreholes were advanced, one	Alluvial groundwater was not present or the measured

TABLE 1-1 DATA GAP ACTION SUMMARY				
Mine Area	**Data Gap**	**Proposed Action to Address Data Gap**	**Action(s) Completed**	**Significant Findings**
	of the center Henry Mine pit (MMP042) near the haul road.	indicator of impacts to groundwater.	groundwater sample collected, the other location was dry.	selenium concentration was below the detection limit.
	Spring survey to the northeast of MMW022 down a drainage cutting the Dinwoody Formation. In addition, a monitoring well should be installed in the Dinwoody Formation near the Little Blackfoot River near the north edge of MWD088.	Spring survey to be completed and a monitoring well to be installed in probable flowpath.	Spring survey completed Monitoring well MMW028 installed.	No springs located in the area of interest. The selenium concentration measured in MMW028 was 0.0026 mg/L and below the State of Idaho groundwater standard.
	If alluvium is impacted this could be a source to the Wells Formation in the general Henry Mine area.	Alluvium evaluated to identify areas where the underlying Wells Formation could be impacted.	Direct-push groundwater samples collected.	There is no indication of impacted alluvium overlying Wells Fm.
	Cross-cutting structures may divert flow along the strike of the Wells Formation and wells located on the north end of the mine along the Little Blackfoot River may not be hydraulically connected to the south end.	Monitoring of water level responses across the probable structure where the Little Blackfoot River crosses the mine.	Water level monitoring is ongoing.	Pending
Enoch Valley Mine	Monitoring wells are installed at the alluvium/Dinwoody Fm. contact. Potential seasonal and shallower alluvial flow needs to be evaluated. Also need greater spatial coverage. Southern Mine Area - MWD092 (Stormwater ponds	Direct-push program utilizing selenium as an indicator of impacts to groundwater.	28 direct-push boreholes were advanced, 24 groundwater samples collected, four locations were dry. Seven direct-push alluvial wells installed.	Selenium concentrations were below 0.005 mg/L at all locations except two where the concentrations were up to 0.05 mg/L.

TABLE 1-1 DATA GAP ACTION SUMMARY				
Mine Area	**Data Gap**	**Proposed Action to Address Data Gap**	**Action(s) Completed**	**Significant Findings**
	MSP017 through MSP021)			
	Alluvial groundwater has not been located or sampled. Northern Mine Area, – west of MWD091	Direct-push program utilizing selenium as an indicator of impacts to groundwater	Ten direct-push boreholes were advanced, three direct-push groundwater samples collected, and seven locations were dry. Two direct-push alluvial wells installed.	The alluvium was generally found to be dry. Where shallow groundwater was found, concentrations were less than 0.005 mg/L.
	Shallow Dinwoody Fm. not impacted, but deeper flowpath from beneath the interior of MWD092 has not been evaluated. Southern Mine Area, west of MWD092, near MDS025	Deeper Dinwoody Formation well installed near MMW013.	Monitoring well MMW024 was installed.	Total selenium concentration was 0.014 mg/L in the fall of 2008.
	Potential Dinwoody Fm. flowpath has not been tested in the northern portion of the mine area west of MWD091 near MMW012	Dinwoody Formation well to be installed near MMW012. May be contingent on alluvial impacts.	Monitoring well MMW027 was installed.	Total selenium concentration was 0.31 mg/L in the fall of 2008.
	Shallow Dinwoody Fm. not impacted, but deeper flowpath from beneath the interior of MWD092 has not been evaluated. In the southern mine area, south of MWD092 near MDS026.	Well location nested with MMW007.	Monitoring well MMW025 was installed.	Total selenium concentration was 0.00088 mg/L in the fall of 2008.
	Wells Formation flow system down-dip of open pit has not been evaluated.	None - Monitor well installation technically challenging in this area. Addressing this data gap is deferred pending results	None	----

TABLE 1-1 DATA GAP ACTION SUMMARY				
Mine Area	**Data Gap**	**Proposed Action to Address Data Gap**	**Action(s) Completed**	**Significant Findings**
		from other Wells Fm. studies per Interim Groundwater Report (MWH, 2008c).		
	MMW009 is in place in the northern portion of the mine area. The center and southern portions are not covered. However, due to the steep dip of the Wells Formation, well installation in the central area will be difficult.	Installation of a new Wells Formation well on the southern end of the backfilled Enoch Valley mine pit.	Monitoring well MMW026 was installed.	Total selenium concentration was 0.0013 mg/L in the fall of 2008.
	An evaluation is needed to assess if the structure causing the change in geologic strike in the northern portion of the mine, along the north side of the unbackfilled portion of MMP045, provides an enhanced groundwater pathway.	Field evaluation of the flexure area.	Field expression in this area is limited, historic pit mapping was reviewed.	P4 mapping in the pit does indicate a fault in this area that offsets the Phosphoria Formation.

2.0 DATA FROM 2007 AND 2008 INVESTIGATION ACTIVITIES

This section presents and discusses investigation and characterization activities and data collected in 2008 and, in the case of surface water sampling, also 2007. The major activities addressed include the mapping and geologic reconnaissance activity, hydrogeologic characterization activities, surface water and groundwater sampling, water balance analysis, and a general (major ion) water quality analysis. Detailed assessment of the data is reserved for the SI Report and not presented herein. However, sufficient assessment is conducted so that identified or newly identified data gaps can be discussed in Section 3.

2.1 Mapping and Geo-reconnaissance Data

In 2007 the waste rock dump boundaries were adjusted by overlaying the existing boundaries with recent U.S. Geological Survey orthophotography. This was further refined in 2008 as specific areas were evaluated. In addition, as a specific task, field geo-reconnaissance was conducted to further field verify the boundaries and identify any areas where significant mass wasting off of the waste rock dumps may have expanded the footprint of the areas.

The field geo-reconnaissance was conducted between June 23 and June 29, 2008 by a MWH geologist with assistance from P4 personnel. Before entering the field, locations of interest were highlighted using digital orthophotography. At the Ballard Mine, an isopach map highlighting changes in pre-mine and post-mine surface elevation was also used. Most areas of interest were predetermined to be in Ballard and Henry Mines with minor boundary updates needed in the western section of Enoch Valley Mine. Waste rock dumps were scouted by vehicle or on foot depending on access. Modifications to the mapping were delineated by walking the area on foot and using a GPS to plot the changes. Points were recorded whenever there was a significant change to the boundary.

The refinement of the boundaries has also allowed for estimates of volume and area of the waste rock dumps and pits to varying degrees. This effort is described in this section.

2.1.1 Ballard Mine Mapping

Prior to 2008, both pre-mine and post-mine topography was available. This allowed for the comparison of the land surface pre-mining and post-mining. An isopach surface indicating the net increase or decrease in the land elevation was developed. This process is the basis for the volume calculation presented in Section 2.1.4. This process was also very useful in identifying mine waste rock dump and pit boundaries. As a result, the mine waste boundaries were well defined, and the geo-reconnaissance resulted in no significant modifications to the waste rock and pit boundary mapping at Ballard Mine as presented on Drawing 2.

Several areas at Ballard Mine were investigated because there was variation in the isopach surface or visible disturbance of the area. Two areas where ground disturbances were apparent on aerial photography, but the isopach mapping indicated no significant change in the land surface, were investigated. One area is located south of mine pit MMP036 and the other is south of mine pit MMP039. Both areas were found to have been disturbed by mining activities, but did not contain waste rock. Neither area had been previously mapped as waste rock, so the investigation confirmed previous work.

A third area on the south edge of mine pit MMP037 was previously mapped as waste rock. However, the isopach surface indicated a slight lowering of the land surface. It appears that this location had the top soil removed exposing the Meade Peak Formation, possibly for exploration or pit development purposes. This causes the area to look disturbed like waste rock, but a thick accumulation of broken waste shale is not exposed, like in a waste rock dump. However, runoff from this area could produce impacted water quality due to possible contact with exposed Meade Peak rocks. However, given that runoff from this area is directed into the mine pit and not an exterior area, this does not warrant further investigation.

Mass wasting and erosion were observed on waste rock dumps MWD081, MWD082, MWD083, and MWD093. On the eastern side of the mine east of MSP062 and upgradient of MST095 there is a storm water channel originating from MMP040. The storm water channel is moving material downstream from the adjoining waste rock dump. This channel is shown in Figure 2-1.

Figure 2-1 – Erosion Channel Originating at MMP040. This view is looking down the channel toward where it drops off of a gap in MWD082. Currently the channel is well vegetated and appears relatively stable.

2.1.2 Henry Mine Mapping

Post-mining topography for the Henry Mine was recently obtained and converted to a datum compatible to the pre-mine topography. These data were used for a mine waste rock, pit boundary and volume analysis using the isopach approach similar to that completed for the Ballard Mine. The analysis was used along with the geo-reconnaissance information to refine the Henry Mine waste rock and mine pit boundaries presented on Drawing 3.

Generally, the mine boundaries at Henry can be well defined by the digital orthophotography. An exception is in the area between the south and center Henry Mine pits (MMP044 and MMP042) and near the current P4 Haul Road. It was unclear from the aerial photography as to what represented disturbed ground or mine waste rock deposition. The majority of changes in the Henry Mine boundaries were in this area.

The most significant change was the revision of the boundaries of MWD086, MWD087 and MWD090 connecting them near and around MSP014, the current P4 Haul Road, and Long Valley Road. The large disturbed area around these dumps has now been classified as waste rock. In addition to this adjustment, the northern and western boundary of MWD088 was updated and redrawn.

Mass wasting and erosion were observed on the slopes of MWD088 near. The small amount of erosion is to the east of the old Henry haul road near the Little Blackfoot River. Although close to the Little Blackfoot River, the sediment retention structures are still in place. Therefore, minor amount of sediment that may be eroding from this area is retained and is not reaching the river. Overall, the reclaimed Henry Mine waste rock dumps appear stable.

In addition to the evaluation of the mine boundaries and mass wasting features during the geo-reconnaissance, a spring survey in the drainage east of monitoring well MMW022 was conducted on June 25, 2008. This was done to address potential flow in the Dinwoody Formation through the ridge to the east from the Henry Mine from waste rock dump MWD086. No springs were identified in the drainage.

2.1.3 Enoch Valley Mine Mapping

Currently, the mine waste and pit boundary mapping for the Enoch Valley Mine is based on aerial photography and mapping maintained by P4 documenting the reclamation progress. The Enoch Valley mine is the most recently reclaimed and the reclamation work continues to be monitored. Therefore, mass wasting and erosion are not significant concerns at this time. Mine waste boundaries are also relatively well defined. However, as the result of the geo-reconnaissance effort the western border of MWD091 was updated.

An isopach analysis for Enoch Valley Mine will be completed in 2009 once the pre-mine and post-mine topography are fully developed and transformed into compatible coordinate systems. However, the boundaries presented in Drawing 4 have a higher level of initial confidence compared to the previous Ballard and Henry mapping due to the younger age of the mine and the availability of P4 mapping.

2.1.4 Volume Calculations

Mine waste rock dump and mine pit volumes and areas were calculated during 2008 and 2009 from the available pre-mine and post-mine topography utilizing earthworks engineering packages in CADD. The pre-mine topographic base in all cases was U. S. Geological Survey digital elevation models (DEM) based on 24,000-scale topographic mapping for the mine areas. The sources of post-mine topography varied by mine as described below in the individual mine discussions. It should also be noted that estimations to date should only be used for site characterization and remedy screening. Additional detailed estimates would be needed for engineering uses.

For Ballard Mine area, the pre-mine topography was compared to post-mine topography. The post-mine topography was produced for P4 from an aerial survey in 2005. The volumes provided in Table 2-1 are an accurate estimation of the mine area configuration based on the available topographies. The exception is areas of partial pit backfill that are contained in MMP035 and MMP036. Because ultimate pit topography is not available, it is not possible to accurately calculate the volume of backfill in the mine pits. However, in the case of the Ballard Mine, the amount of backfill is relatively minor and no attempt was made to estimate the volume. Historical_P4 records indicate that approximately 18 million cubic yards (mcy) of mine waste were hauled to the external dumps. This correlates with the volume calculations based on current topography and pre-mine topography presented in Table 2-1.

TABLE 2-1 BALLARD MINE WASTE ROCK DUMP AND MINE PIT AREAS AND VOLUMES				
Waste Dump/ Mine Pit	**Net Fill (cu. yd.)**	**Net Cut (cu. yd.)**	**2D Area[1] (sq. ft.)**	**3D Area[2] (sq. ft.)**
MWD080	4,990,000	---	3,520,000	3,670,000
MWD081	3,920,000	---	2,060,000	2,180,000
MWD082	3,040,000	---	3,170,000	3,330,000
MWD083	608,000	---	727,000	760,000
MWD084	1,140,000	---	1,270,000	1,320,000
MWD093	5,060,000	---	2,860,000	3,030,000
MMP035	---	13,200,000	4,030,000	4,730,000
MMP036	---	5,850,000	2,680,000	2,970,000
MMP037	---	2,660,000	1,020,000	1,150,000
MMP038	---	21,800	56,200	60,200
MMP039	---	844,000	1,030,000	1,100,000
MMP040	---	1,230,000	905,000	982,000
TOTAL	**18,800,000**	**23,800,000**	**23,300,000**	**25,300,000**
Acres:			**534**	**581**

Notes:
Calculated areas and volumes have been rounded to three significant figures.
(1) - 2D area is the area in a horizontal map view
(2) - 3D area is the surface area that accounts for the topography
--- = not applicable

For the Henry Mine area, the volume estimates presented in Table 2-2 were based on the pre-mine topography and a new topographic survey completed for P4 in 2008. The waste rock dump boundaries for the Henry Mine include the mine pit backfill areas (Drawing 3), which because the pits were not backfilled to original grade, these areas generally show as a net cut volume.

TABLE 2-2 HENRY MINE WASTE ROCK DUMP AND MINE PIT AREAS AND VOLUMES				
Waste Dump/ Mine Pit	**Net Fill[1] (cu. yd.)**	**Net Cut[2] (cu. yd.)**	**2D Area[4] (sq. ft.)**	**3D Area[5] (sq. ft.)**
MWD085	2,500,000	---	2,850,000	2,890,000
MWD086	11,200,000	---	12,100,000	12,400,000
MWD087	6,570,000	---	3,760,000	3,870,000
MWD088	3,650,000	---	3,190,000	3,260,000
MWD090	8,390,000	---	4,340,000	4,480,000
MMP041[3]	---	6,500,000	4,230,000	4,900,000
MMP042	---	837,000	1,640,000	1,700,000
MMP043	---	11,500,000	6,140,000	6,610,000
MMP044[3]	---	13,600,000	3,960,000	4,640,000
TOTAL	**32,300,000**	**32,400,000**	**42,200,000**	**44,800,000**
Acres:			**969**	**1,030**

Notes:
Calculated areas and volumes have been rounded to three significant figures.
(1) - Fill volumes and areas are for the external waste rock dumps; the portion of the dump within mine pit boundaries is not included.
(2) - Net cut volume is from below original grade and does not include backfilled volume of the mine pits.
(3) - Pits MMP041and MMP044 contain unbackfilled volume.
(4) - 2D area is the area in a horizontal map view
(5) - 3D area is the surface area that accounts of the topography
--- = not applicable

Therefore, the fill volumes for the waste rock dumps are estimated for the areas *external to the mine pit areas only*. Cut volumes in Table 2-2 include both unbackfilled mine pit volumes as well as the volume of the unfilled portion up to original grade above any pit backfill. The areas presented correspond to the volumes estimated (e.g., only external areas or estimated pit areas).

Rough estimates for the pit backfill volumes were calculated for the Henry Mine. P4 records indicate that 99.6 mcy of waste rock was moved at the Henry Mine. The estimated volume in the external waste rock dumps is 32.3 mcy (Table 2-2). Therefore, 67.3 mcy are estimated to be contained in the Henry mine pits as backfill.

For the Enoch Valley Mine area, the volumes estimated in Table 2-3 were based on the pre-mine topography and the topography in the GIS database maintained by P4. The waste rock dump boundaries for the Enoch Valley waste rock dump MWD091 include the mine pit backfill areas, which because the pits were not backfilled to original grade, would show as a cut volume. Therefore, the fill volume for the waste rock dump MWD091 is estimated for the external dump area only. Waste rock dump MWD092 is defined as only an external dump.

TABLE 2-3
ENOCH VALLEY MINE WASTE ROCK DUMP AND MINE PIT AREAS AND VOLUMES

Waste Dump/ Mine Pit	Net Fill(1) (cu. yd.)	Net Cut (cu. yd.)	2D Area(5) (sq. ft.)	3D Area(6) (sq. ft.)
MWD091	8,130,000	---	8,910,000(4)	10,500,000(4)
MWD092	14,100,000	---	10,600,000	10,800,000
MMP045(2)	---	8,500,000	2,200,000	2,600,000
MMP045(3)	---	3,380,000	--	--
TOTAL	**22,200,000**	**11,900,000**	**21,700,000**	**23,900,000**
	Acres:		**498**	**549**

Notes:
Calculated areas and volumes have been rounded to three significant figures.
(1) - Fill volume is for the external waste rock dumps; the portion of the dump within mine pit boundaries is not included.
(2) - Unbackfilled portion of mine pit
(3) - Net cut volume above backfill, below original grade, and does not include backfilled volume.
(4) - Includes external dump and backfill areas.
(5) - 2D area is the area in a horizontal map view
(6) - 3D area is the surface area that accounts of the topography
--- = not applicable

Two cut volumes for mine pit MMP045 were estimated, one for the largely unbackfilled area, and one for backfilled areas that includes the cut volume between the backfill surface and the original grade.

P4 records indicated that approximately 51.5 mcy of waste rock was moved at the Enoch Valley Mine. The calculations presented in Table 2-3 indicate that an estimated 22.2 mcy is contained in the external waste rock dumps; therefore, the mine pit contains an estimated 29.3 mcy of waste rock as backfill.

2.2 Summary of Hydrogeologic Field Program

The 2008 hydrogeologic characterization field program for the three mines consisted of two major activities. The first of these was the direct-push sampling activity (MWH, 2008b). This activity specifically focused on sampling groundwater in the alluvial and colluvial groundwater systems downgradient of the mine waste rock dumps. This activity proved to be effective for obtaining a large number of samples for selenium analysis and installing a number of long-term groundwater monitoring points. The second activity was the monitoring well installation task that focused on characterizing groundwater in the bedrock units near the mines (MWH, 2008a). Each of these programs and the data collected from them are described in this section. Other items described in this section include, an aquifer testing program, miscellaneous hydrogeologic activities, such as water level monitoring, and any significant deviations from the planned work.

2.2.1 Direct-Push Sampling

A total of 127 direct-push boreholes were advanced in the alluvial and colluvial deposits associated with the three mines between May 13 and June 20, 2008. The locations of these boreholes are shown on Drawings 5 through 10, with the general areas of investigation shown on Drawing 1. The equipment used for the activity was a Geoprobe™ 6620DT operated by Earth Probe Environmental of Bountiful, Utah. Two types of boreholes were advanced - Stage 1 and 2 boreholes. Stage 1 boreholes were cored and logged down to sample depth and Stage 2 boreholes were pushed down to sample depth without core logging. Thirty-four Stage 1 boreholes and 93 Stage 2 boreholes were completed.

From the 127 boreholes, 90 reconnaissance-type grab groundwater samples were collected in Spring 2008 and one borehole, BH016, had two grab samples taken at different depths within the same boring. MBW026, which was dry in spring, was later sampled during the Fall 2008 event. Of the 127 boreholes, 32 were dry and five met refusal before reaching the desired depth. In addition to the grab groundwater samples collected, 13 long-term monitoring wells were installed using prepacked well screen and PVC riser pipe. Of these, eight were installed at Ballard Mine and five at Enoch Valley Mine. A MWH field geologist observed and documented the drilling and well construction activities, collected soil samples, and prepared geologic and well completion logs.

A summary of the groundwater sampling results is provided in Section 2.3.3. A complete discussion of the procedures and results of the direct-push activity is provided in the Direct-Push Groundwater Sampling Technical Memorandum in Appendix A.

2.2.2 Monitoring Well Installation

Eight new monitoring wells were installed at Ballard, Henry and Enoch Valley Mines from July 8 through August 16, 2008. Drilling and installation of the new wells was conducted by A.K. Drilling, Inc. A MWH field geologist observed and documented the drilling and well construction activities, collected soil samples, and prepared geologic and well completion logs. A Foremost DR-12 air-rotary drilling rig was used to drill each boring. Potable water from the Enoch Valley Mine shop was added to the drilling air to suppress dust and facilitate circulation of drill cutting. The locations of the existing well and the new wells installed in 2008 are shown on Drawings 11 and 12, and locations with respect to the geologic mapping are shown on Drawings 13 and 14.

2.2.2.1 Well Installation and Development Procedures

A field geologist supervised the drilling operations and produced drilling logs noting lithology, sampling interval, and other pertinent information. Chip samples were collected approximately every five feet and stored in chip boxes. Large chip collections, about a pound, were collected at first groundwater and the bottom of the boring, with some wells having large samples taken every five feet. These large samples were archived for possible future testing. All groundwater monitoring wells installed during this investigation were constructed according to the Idaho Department of Water Resources (IDWR) guidelines (a minor deviation from the standard specification occurred with MMW026 as discussed in Section 2.2.5.2).

A field geologist monitored all well installation procedures performed by the drilling company and recorded dates and times of the drilling events (e.g., first indication of groundwater). In general, wells were installed by drilling an 8-inch diameter borehole while advancing temporary 8-inch steel casing to near the bottom of the borehole. As the borehole was advanced towards the target depth, the rock type being drilled through was confirmed and the water bearing intervals were identified. The wells were screened at the desired depth and completed using 4-inch diameter, flush-threaded PVC casing to approximately three feet above ground. Either Schedule 40 or 80 PVC was used for well screen and riser pipe. Silica sand and bentonite chips were added to the annular space as needed to properly complete the well. A twenty foot section of 8-inch-diameter steel casing was left in the ground, with approximately four feet remaining above ground as a protective monument. A locking cover, concrete pad and protective bollards were also installed. Table 2-4 presents well construction details and Appendix B contains the drilling logs and well completion diagrams. Additional information for each of the new wells is given below for each mine.

Well development of seven of the eight wells was conducted by MWH from August 20 through August 27, 2008. Well MMW026 was developed by Independent Drilling because the depth was too deep to allow use of manually deployed equipment. The wells were developed by first bailing to remove fines settled in the bottom of the well. The wells were then surged with a surge block to pull fines into the well and create groundwater flow reversals (surging) in and out of the well. The surge process develops a connection between the filter pack and the surrounding aquifer sediments. After surging, the well was bailed again to determine if the turbidity was within safe levels for the pumping equipment. The well was either bailed or pumped, depending on the turbidity. After the well was either pumped dry, several well volumes were purged, or the turbidity dropped below 100, the well was surged again. This process was repeated until the well was within sampling parameters and at least three times the well's volume had been purged. A Grundfos Redi-Flo 3 pump with 1 and ¼-inch-diameter tubing was used to purge the wells.

TABLE 2-4
2007 AND 2008 NEW WELLS
DRILLING AND CONSTRUCTION DETAILS

Mine	Well ID	Well Location	Date Installed	Boring TD (ft bgs)	Depth Water Encountered when Drilling (ft bgs)	Depth to Formation Contacts (ft bgs)[1]	Well Completion TD (ft bgs)	Screened Interval [Length] (ft bgs)	Screen Slot Size (in)	Sand Size at Screen	Primary Filter Interval (ft bgs)	Bentonite Seal (Pellet) Interval (ft bgs)	Bentonite Seal (Slurry) Interval (ft bgs)	Drill Shoe Burial (ft bgs)	Backfill (ft bgs)	Permanent Steel Casing (ft bgs)
Ballard Mine	MMW006	South of West Ballard Pit; south of waste rock dumps	7/23/2007	335	315-335	**0-Wells**	330	330-310 [20]	0.020	10x20	335-305 *20x40 sand 305-300*[2]	300-290	290-surface	NA	NA	NA
	MMW017	Northwest of Ballard Mine into Long Valley Creek alluvial flow field	8/27/2007	62	35	**0-Alluvium**	57	56-36 [20]	0.010	20x40	56-31	31-20	20-surface	NA	Pellets 32-60; 20x40 sand 60-56	NA
	MMW018	East of Ballard Mine in Wooley Valley alluvial flow field	8/12/2007	33	31	**0-Alluvium 30-Dinwoody**	33	33-18 [15]	0.010	20x40	33-15	15-10	10-surface	NA	NA	NA
	MMW020	East side of West Ballard Pit (MMP035); replacement of MMW001	10/5/2007	416	225, 250, 315, 370	0-Rex Chert **370-Wells**	408	408-388 [20]	0.010	20x40	408-378	378-368	368-surface	Pellets 416-413; 20x40 sand 413-408	NA	NA
	MMW021	West side of West Ballard Pit (MMP035); replacement of MMW002	9/24/2007	260	229, 238	0-Waste Rock **25-Wells**	250	250-230 [20]	0.010	20x40	250-219	219-210	210-surface	Pellets 260-255; 20x40 sand 255-250	NA	NA
	MMW029	East Ballard mine area upgradient of MMW018	7/17/2008	61	60	0-Alluvium **25-Dinwoody**	60	60-45 [15]	0.020	10x20	60-40	40-surface[3]	NA	16	NA	16
	MMW030	Along the southwestern portion of Ballard Mine in the vicinity of MW-16A	7/10/2008	221	155	0-Alluvium **75-Wells** 170-Phosphoria	155	155-135 [20]	0.010	20X40	155-130	130-surface[3]	NA	16	221-155 Bentonite (Chips)	16
	MMW031	Along the western perimeter of Ballard Mine north of MMW017 and on the east side of the haul road.	7/12/2008	201	120, 185	0-Alluvium **160-Wells**	200	200-180 [20]	0.010	20x40	200-175	175-surface[3]	NA	16	NA	16
Henry Mine	MMW010	Southeast of Center Henry Pit; near MPW023	9/9/2007	38	17	**0-Alluvium**	32	32-12 [20]	0.010	20x40	32-8	NA	8-surface	NA	20x40 sand 38-32	NA
	MMW011	Northwest of Center Henry Pit; south of Little Blackfoot River	9/8/2007	120	101	**0-Wells**	115	115-95 [20]	0.010	20x40	115-85	85-75	75-surface	NA	20x40 sand 120-115	NA
	MMW014	Southeast of Henry Mine center pit in Lone Pine Creek alluvial flow field	8/11/2007	22	9	**0-Alluvium**	22	22-7 [15]	0.010	20x40	22-4	4-surface	NA	NA	NA	NA
	MMW019	North of Henry Mine center pit	8/10/2007	14	10	**0-Phosphoria**	14	14-4 [10]	0.020	10x20	14-3	3-1	NA	NA	NA	NA
	MMW022	Northeast lobe of Henry Mine waste rock dump MWD086	7/28/2007	360	320, 340	0-Waste Rock **5-Dinwoody**	326	326-306 [10]	0.020	10x20	326-286 *20x40 sand 286-281*[2]	281-271	271-surface	NA	Boring caved 360-326	NA
	MMW023	Henry Mine North Pit (MMP041)	9/11/2007	362	128, 188	0-Phosphoria **350-Wells**	357	357-352 [5]	0.010	20x40	357-350	350-340	340-surface	Pellets 362-361; 20x40 sand 361-357	NA	NA
	MMW028	Near the Little Blackfoot River northwest of MMW019	7/15/2008	100	80, 100	0-Alluvium 40-Basalt 63-Alluvium **70-Dinwoody**	96	96-76 [20]	0.010	20x40	96-70	70-surface[3]	NA	16	Boring Caved 100-96	16

TABLE 2-4
2007 AND 2008 NEW WELLS
DRILLING AND CONSTRUCTION DETAILS

Mine	Well ID	Well Location	Date Installed	Boring TD (ft bgs)	Depth Water Encountered when Drilling (ft bgs)	Depth to Formation Contacts (ft bgs)[1]	Well Completion TD (ft bgs)	Screened Interval [Length] (ft bgs)	Screen Slot Size (in)	Sand Size at Screen	Primary Filter Interval (ft bgs)	Bentonite Seal (Pellet) Interval (ft bgs)	Bentonite Seal (Slurry) Interval (ft bgs)	Drill Shoe Burial (ft bgs)	Backfill (ft bgs)	Permanent Steel Casing (ft bgs)
Enoch Valley Mine	MMW007	South of EVM South Dump; near edge of dump footprint	8/23/2007	90	88	**0-Alluvium**	89.5	90-70 [20]	0.010	16x30	90-64	64-61	61-surface	NA	NA	NA
	MMW008	South of EVM South Dump; south and downgradient of MMW007	8/25/2007	204	160, 175	**0-Alluvium 130-Dinwoody**	197	197-177 [20]	0.010	16x30	197-170	170-160	160-surface	16x30 sand 204-197	NA	NA
	MMW009	Central North Dump (MWD091)	10/26/2007	563	150 (Wells Fm contact 530)	0-Waste Rock 90-Phosphoria **530-Well**s	554	554-549 [5]	0.010	20x40	554-546	546-536	536-surface	Pellets 563-559; 20x40 sand 559-554	NA	360
	MMW012	Northwest of EVM North Dump in Lone Pine Creek alluvial flow field	8/28/2007	58	Dinwoody contact @ 60 ft-BGL	0-Alluvium 37-Dinwoody	58	58-28 [30]	0.010	20x40	58-23	23-13	13-surface	NA	NA	NA
	MMW013	Southwest of EVM in Rasmussen Creek alluvial flow field	8/13/2007	35	29	0-Alluvium **6-Dinwoody**	35	35-25 [10]	0.020	10x20	35-21	21-16	16-surface	NA	NA	NA
	MMW024	Along the south end of Enoch Valley Mine, upgradient of MMW013	7/25/2008	201	15, 60, 100, 140	0-Alluvium **10-Dinwoody**	200	200-180 [20]	0.020	10x20	201-175	175-surface [3]	NA	16	NA	16
	MMW025	Along the south end of Enoch Valley Mine, near MMW007	7/28/2008	201	58,160	0-Alluvium **115-Dinwoody**	200	200-180 [20]	0.020	10x20	201-175	175-surface [3]	NA	16	NA	16
	MMW026	Northeast of MPW006 and MMW008	8/11/2008	363	6, 65, 100, 200, 300	0-Alluvium **218-Wells**	355	355-335 [20]	0.010	20x40	355-330	330-surface [3]	NA	322	Boring Caved 363-355	322
	MMW027	Near MMW012	8/15/2008	123	88	0-Alluvium 20-Basalt 45-Alluvuim **53-Dinwoody**	120	120-100 [20]	0.010	20x40	120-95	95-Surface [3]	NA	16	NA	16

Notes:
(1) - Bold indicates formation at screened interval
(2) - Italics indicates sand size and interval of secondary filter
(3) - Chips were used instead of pellets

2.2.2.2 Well Installation Results

The following text provides summary descriptions by mine area of the individual monitoring wells installed in 2008.

<u>Ballard Mine Monitoring Well Installations</u>

Three new bedrock monitoring wells were installed in the Ballard Mine area to address data gaps identified in 2007. One monitoring well was installed on the eastern edge of the mine targeting the intermediate Dinwoody Formation groundwater system, and two monitoring wells were installed on the western edge of the mine targeting the regional Wells Formation groundwater system.

Monitoring Well MMW029

MMW029 is located in Wooley Valley on the eastern edge of the Ballard Mine area near MWD082. The location of MMW029 was originally sited downgradient of MMW018 with the intention of being modified based on information gathered from the direct-push sampling activity. The well was relocated 1,600 ft upgradient from its initial proposed position. The modified location places the monitoring well as close to MWD082 as was practical, and in an area of elevated alluvial groundwater selenium concentrations as indicated by the direct-push sampling results.

MMW029 was drilled through two stratigraphic units to a depth of 61 ft bgs, and completed on July 17, 2008. The first unit drilled consisted of alluvium down to a depth of 25 ft bgs. Below the alluvium, Dinwoody Formation was encountered to the total depth of the drill hole. The relative position of MMW029 in relationship to the geology is illustrated on the Geologic Map and Section S, Drawings 13 and 17, respectively. The well screen was placed in fractured Dinwoody Formation claystone.

The well was screened in the Dinwoody Formation from 45 to 60 ft bgs using 0.020 slotted, schedule 40 PVC screen. Groundwater flow into the drill hole was observed to be approximately 60 gpm during drilling (air lift) with a static water level of 25 ft bgs. A 10X20 sand filter pack interval extends from 40 to 60 ft bgs with a bentonite seal extending from 40 ft bgs to the surface. During the fall 2008 sampling event, total selenium was detected at 0.81 mg/L.

Monitoring Well MMW030

MMW030, near MWD081 on the southwestern edge of Ballard Mine, was drilled to a depth of 221 ft bgs and was completed on July 10, 2008. The first stratigraphic unit was alluvium consisting of clays, sands, and gravel in samples collected from 0 to 75 ft bgs. The second unit encountered was Wells Formation from a depth of 75 to 170 ft bgs consisting of light olive and gray limestone. Below the Wells Formation is a black chert that appears to be part of the Phosphoria Formation. This suggests a fault was crossed or an overturned sequence is present. The relative position of MMW030 with respect to the Ballard geology is illustrated on the Geologic Map and Section U, Drawings 13 and 18, respectively.

Groundwater was observed during drilling to flow into monitoring well MMW030 at approximately 0.5 gpm with a static water depth of 26 ft bgs after well completion. The drill hole was backfilled from 155 to 221 feet so that the well could be screened in the Wells Formation, from 135 to 155 ft bgs. The 20X40 sand filter pack extends from 130 to 155 ft bgs with bentonite chips creating a seal to the surface from the top of the filter pack. During the fall 2008 sampling event, total selenium was measured at below the detection limit (<0.0010 mg/L).

Monitoring Well MMW031

MMW031 was drilled to a depth of 201 ft bgs between the P4 Haul Road and MWD081 north of the Ballard Mine Shop area. The monitoring well was completed on July 12, 2008. The first stratigraphic unit drilled in this boring was alluvium to a depth of 160 ft bgs. The remaining 41 feet of the borehole was drilled into the Wells Formation. The relative position of MMW031 in the Ballard Mine geology is shown on Drawing 13. The well is not shown in section due to the simple geology and lack of other nearby data points.

The monitoring well was constructed with schedule 40 PVC, 0.010 slot well screen set at 180-200 ft bgs. The 20X40 sand filter pack extends from approximately 175 to 200 ft bgs with a bentonite chip seal extending to the surface. Groundwater was observed during drilling to be flowing into the well at an estimated 35 gpm with a static water level of approximately 100.8 ft bgs. Groundwater collected from the well during the fall 2008 sampling event contained a total selenium concentration of 0.00087 mg/L.

Henry Mine Monitoring Well Installations

One new monitoring well was installed at the Henry Mine to address a possible flowpath in the intermediate Dinwoody Formation groundwater system.

Monitoring Well MMW028

Monitoring well MMW028 was drilled to a depth of 100 ft bgs through four stratigraphic units and was completed on July 15, 2008. The first unit drilled through was alluvium, from 0 to 40 ft bgs, followed by vesicular basalt from 40 to 63 ft bgs, alluvium from 63 to 70 ft bgs, and then Dinwoody Formation from 70 to 100 ft bgs. While drilling through the basalt unit, there was a loss of drill fluid circulation likely due to fractures. When the drill fluid circulation was lost, drill foam was used to remove cuttings from the bottom of the borehole. After completion of the boring at 100 ft bgs, the bore hole caved to 96 ft bgs where groundwater flow was estimated at approximately 70 gpm during drilling with a static water level of 79 ft bgs. The position of MMW028 is shown on the Geologic Map (Drawing 14) and on Section V (Drawing 20).

Groundwater was encountered in the boring at 80 and 100 ft bgs. The monitoring well was constructed with the Schedule 40 PVC, 0.010 slot screen set from 76 to 96 ft bgs. The 20X40 sand filter pack extends from 70 to 96 ft bgs with a bentonite chip seal extending from 70 ft bgs to the surface. In the Fall of 2008, the total selenium concentration measured in MMW028 groundwater was 0.0026 mg/L.

Enoch Valley Mine Monitoring Well Installations

Four new monitoring wells were installed in the Enoch Valley Mine area in 2008. These wells were primarily installed to address a potential flowpath in the Dinwoody Formation, but one well was installed into the Wells Formation.

Monitoring Well MMW024

MMW024 is upgradient of monitoring well MMW013 on the southwest side of waste rock dump MWD092. The boring was drilled to a depth of 201 ft bgs. The first 10 ft of the boring was drilled through alluvium consisting of primarily clay. The remaining 191 ft of drilling was in the Dinwoody Formation comprised of alternating beds of dark gray to reddish black limestone and olive green claystone. The relative position of MMW024 is shown on Section K (Drawing 22) and on the Geologic Map (Drawing 14).

The well was completed on July 25, 2008. Groundwater flow was estimated at rate of 40 gpm during drilling with a static water level of 65.22 ft bgs. A 0.020 slotted, schedule 40 PVC, well screen was set at 180-200 ft bgs in the Dinwoody Formation. The 10X20 sand filter pack extends from 175 to 201 ft bgs and the bentonite chip seal from 175 to the surface. During the fall 2008 sampling event, total selenium was detected at 0.014 mg/L.

Monitoring Well MMW025

MMW025 is located just northwest of the intersection of Rasmussen Valley Road and the Agrium Haul Road and was completed July 28, 2008. The well was installed at the depth in which the first groundwater yield was encountered in the Dinwoody Formation. The total boring depth was 201 ft bgs. The first stratigraphic unit drilled was alluvium to a depth of 115 feet. The remaining 86 feet was in the Dinwoody Formation with rock consisting of finely laminated claystone and occasional limestone beds. The relative position of MMW025 is shown on the Geologic Map (Drawing 14) and Section D (Drawing 21).

Groundwater was observed to be flowing into the well at an estimated 0.5 gpm during drilling with a static water level of 32 ft bgs. The well was constructed with schedule 40 PVC well screen at 180-200 ft bgs. The 10X20 sand pack extends from 175 to 201 ft bgs with a bentonite chip seal extending from the top of the filter pack to the surface. During the Fall 2008 sampling event, total selenium was detected at 0.00088 mg/L.

Monitoring Well MMW026

MMW026 was drilled to a depth of approximately 363 ft bgs and completed on August 11, 2008. This monitoring well is located on the southeast end of Enoch Valley Mine waste rock dump MWD092, northeast of the intersection of Rasmussen Valley Road and the Agrium Haul Road. MMW026 was relocated in the field to adjust for the Enoch Valley Fault as described in Section 2.2.5.2. The first stratigraphic unit drilled was alluvium to 218 ft bgs consisting of clays, sands, and gravels. The second formation drilled was Wells Formation from 218 to 363 feet. Wells Formation at this location is comprised of light gray limestone with some red clays and a lower unit of light yellow and gray sandstone. The relative position and geology at MMW026 is illustrated on Section J (Drawing 21) and the Geologic Map (Drawing 14).

Groundwater flowed into the well at an estimated rate of 40 gpm during drilling with a static water level of 287.6 ft bgs. The well screen was set at 335 to 355 ft bgs and was constructed with schedule 80 PVC. Due to expansive clays, the drillers were unable to pull 322 feet of 8-inch-diameter protective casing from the ground as described in Section 2.2.5.2. The sand filter pack extends from 330 to 355 feet with a bentonite chip seal extending to the surface beneath and inside the protective casing. The seal outside of the casing consists of the native clays (see Section 2.2.5.2 for further discussion). Total selenium was detected at 0.0013 mg/L in groundwater samples collected during the Fall 2008 sampling event

Monitoring Well MMW027

MMW027 was drilled to a depth of 123 ft bgs through four stratigraphic units. The first stratigraphic unit drilled was alluvium to a depth of 20 feet. Below the alluvium, is a vesicular basalt from 20 and 45 ft bgs. Below the basalt was a thin layer of alluvium from 45 to 53 ft bgs followed by the Dinwoody Formation to the bottom of the boring at 123 ft bgs. The relative position and geology at MMW027 is illustrated on Section L (Drawing 23) and the Geologic Map (Drawing 14).

The well was completed on August 15, 2008. Groundwater flowed into the well at an estimated rate of 100 gpm during drilling with a static water level at 94.45 ft bgs. The well was constructed with schedule 40 PVC well screen at 100-120 ft bgs. The 10X20 sand filter pack extends from 95 to 120 ft bgs with a bentonite chip seal extending from the top of the filter pack to the surface. A groundwater sample collected during the Fall 2008 sampling event contained 0.31 mg/L total selenium.

2.2.3 Aquifer Testing

Two aquifer test methods were used to evaluate the hydraulic conductivity of the aquifer materials in the mine areas – pneumatic and solid slug testing. The first method was used to evaluate the hydraulic properties at direct-push monitoring wells locations, the second at conventional monitoring well locations. Fourteen direct-push monitoring wells were slug tested between June 14 and June 16, 2008, and 12 twelve monitoring wells were tested between October 5 and October 12, 2008. These wells were selected based on suitability for the test and the hydrogeologic conditions. This section describes the procedures and results of this activity.

2.2.3.1 Aquifer Testing Procedures

June Testing (Direct-Push Monitoring Wells): A pneumatic testing procedure was used for the direct-push monitoring wells. The direct-push wells were initially purged until water was clear from each well and allowed to recover overnight. The pneumatic manifold assembly (PMA) fit atop the well casing and included an air inlet that attached to a foot pump, a pressure gauge, and an air outlet. Where necessary, an air-tight extension from the casing to the PMA was implemented. At the top of the PMA was an airtight outlet for the cord attaching the transducer to the laptop. Water levels were read by the transducer and recorded in the laptop throughout the slug test.

The slug testing procedure began by closing the inlet and release valves that allowed air into the PMA from the air inlet arm with the foot pump as well as the pressure regulator. Pressure was then set in the supply hose that connects the foot pump to the PMA to 40 psi. The inlet valve was then opened, allowing a pressure equivalent to displacing approximately 15 inches of water into the well. Once this pressure was achieved, the inlet valve was quickly closed so the system could stabilize. Typically, there was a significant decrease in the initial pressure, most likely due to small air leaks in the system. Over time the readings returned to the levels noted prior to pressurization. Once this had occurred, the release valve was opened, allowing the system to return to atmospheric pressure. The release of the remaining pressure in the system (typically 70-80% of initial) produced an adequate rebound curve for analyzing the test. This procedure was typically repeated three times for each well where the test was performed.

October Testing (Monitoring Wells): The second round of slug testing was conducted on monitoring wells with a transducer similar to that of the first round of testing and a solid slug for displacing water as opposed to the pneumatic method used at the direct push wells. A 3-foot long slug of either 1 ½-inch or 2-inch diameter was used as corresponded to the various sizes of wells. First a falling head test was performed by instantaneously lowering the slug two feet below the water table and displacing water upward in the well. Water levels were recorded as water moved into the aquifer surrounding the screened interval and eventually returned to its original static depth below the ground surface. Once static water depth was achieved, the slug was removed to record a rising head test by displacing water downward in the well. The water was allowed to rise to its equilibrium water depth, by moving into the well through the screened interval. As before, the transducer recorded magnitudes of these water table fluctuations throughout the test.

2.2.3.2 Aquifer Testing Analyses and Results

The resulting test data and parameters of the well were entered into the AQTESOLV 4.0 computer program to develop curves that estimate the hydraulic conductivity of the sediments or bedrock around the well screen. The Bouwer-Rice (1989) method was selected as the most appropriate solution for these slug tests. The use of the Bouwer-Rice solution assumes the following conditions for the aquifer and monitoring wells:

- aquifer has infinite areal extent
- aquifer is homogeneous and of uniform thickness
- aquifer potentiometric surface is initially horizontal
- test well is fully or partially penetrating
- a volume of water is injected or discharged from the well instantaneously
- aquifer is confined or unconfined
- flow is steady

The input parameters for the AQTESOLV analyses are provided on Tables 2-5 and 2-6, for the direct-push monitoring wells and the conventional monitoring wells, respectively. The resulting hydraulic conductivity of the subsurface surrounding each well is shown in Tables 2-7 and 2-8. The locations of the well tested are shown of Drawings 11 and 12. The AQTESOLV output is provided in Appendix C.

TABLE 2-5
AQTESOLV INPUT PARAMETERS FOR DIRECT-PUSH MONITORING WELLS

	Units	MBW006	MBW009	MBW011	MBW027	MBW028	MBW085	MBW087
Screened Interval	ft bgs	9-13.7	6-10.7	10-14.7	11.5-16.2	15-19.7	7.25-11.95	7-11.7
Casing Diameter	inches	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Saturated Thickness	feet	10.83	13	15	7.1	14.21	9.89	10.81
Anisotropy Ratio	unitless	1	1	1	1	1	1	1
Initial Displacement	feet	0.17	0.24	0.3	0.21	0.23	0.25	0.25
Total Well Penetration Depth	feet	9.53	8.25	13.93	11.8	13.91	9.56	9.51
Test Date	date	6/15/2008	6/15/2008	6/15/2008	6/14/2008	6/16/2008	6/16/2008	6/15/2008

Notes: Pneumatic slug testing was used for the direct-push monitoring wells.

TABLE 2-6
AQTESOLV INPUT PARAMETERS FOR MONITORING WELLS

	Units	MMW007	MMW008	MMW013	MMW014	MW-15A	MW-16A	MMW017
Screened Interval	ft bgs	70-90	177-197	25-35	7-22	30-40	20-30	36-56
Casing Diameter	inches	4	4	4	4	2	2	4
Saturated Thickness	feet	48.8	173.5	22.5	19.1	24.4	25.7	62
Anisotropy Ratio	unitless	1	1	1	1	1	1	1
Initial Displacement	feet	0.423	1.84	0.416	1.84	1.58	1.58	0.38
Total Well Penetration Depth	feet	49.3	174	22.5	19.1	19.4	20.7	56
Test Date	date	10/8/08	10/8/08	10/8/08	10/8/08	10/11/08	10/10/08	10/8/08
Slug Size	unitless	Small	Large	Small	Large	Small	Small	Small
	Units	**MMW024**	**MMW026**	**MMW027**	**MMW028**	**MMW029**	**MMW031**	
Screened Interval	ft bgs	180-200	340-360	100-120	76-96	45-60	180-200	
Casing Diameter	inches	4	4	4	4	4	4	
Saturated Thickness	feet	140	68	90	20	39	103	
Anisotropy Ratio	unitless	1	1	1	1	1	1	
Initial Displacement	feet	1.67	1.84	1.67	1.67	1.67	1.67	
Total Well Penetration Depth	feet	140	73	90	96	43	103	
Test Date	date	10/8/08	10/10/08	10/8/08	10/9/08	10/9/08	10/8/08	
Slug Size	unitless	Large	Large	Large	Large	Large	Large	

Notes: bgs = below ground surface
For monitoring wells, solid slugs were used for testing

TABLE 2-7
HYDRAULIC CONDUCTIVITY RESULTS FOR DIRECT-PUSH MONITORING WELLS

	Units	MBW006	MBW009	MBW011	MBW027	MBW028	MBW085	MBW087
Formation:		Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium
Hydraulic Conductivity	ft/sec	2E-04	8E-06	2E-05	2E-05	6E-06	2E-05	7E-05
	ft/day	2E+01	7E-01	1E+00	2E+00	6E-01	2E+00	6E+00
	cm/sec	6E-03	2E-04	5E-04	6E-04	2E-04	5E-04	2E-03

TABLE 2-8
HYDRAULIC CONDUCTIVITY RESULTS FOR MONITORING WELLS

	Units	MMW007	MMW008	MMW013	MMW014	MW-15A	MW-16A	MMW017
Formation:		Alluvium / Dinwoody	Dinwoody	Dinwoody	Alluvium	Alluvium	Alluvium	Alluvium
Hydraulic Conductivity	ft/sec	2E-06	1E-05	5E-04	2E-05	4E-06	7E-06	7E-06
	ft/day	2E-01	9E-01	5E+01	2E+00	4E-01	6E-01	6E-01
	cm/sec	7E-05	3E-04	2E-02	6E-04	1E-04	2E-04	2E-04
	Units	**MMW024**	**MMW026**	**MMW027**	**MMW028**	**MMW029**	**MMW031**	
Formation:		Dinwoody	Wells	Dinwoody	Dinwoody	Dinwoody	Wells	
Hydraulic Conductivity	ft/sec	2E-04	5E-04	2E-04	1E-03	2E-05	1E-04	
	ft/day	1E+01	4E+01	2E+01	9E+01	2E+00	1E+01	
	cm/sec	5E-03	2E-02	5E-03	3E-02	5E-04	4E-03	

2.2.4 Miscellaneous Tasks

Table 2-9 presents groundwater elevations at monitoring wells in Spring and Fall 2008. The measuring point elevations given are preliminary. Some are based on a different vertical datum than used for the topography displayed on drawings in this report. This will be corrected and updated in future reports. A Solinst Levelogger® data logger was also installed in these wells in the Fall of 2008. The data loggers are recording water level, temperature, and time once each day. Field teams will download the data logger readings in Spring and Fall of 2009. Hydrographs of the readings will be provided in future reports.

TABLE 2-9
2008 GROUNDWATER ELEVATION IN MONITORING WELLS

Well ID	Elevation MP (ft-AMSL)	Static Water Spring (ft-bmp)	Elevation Static Water Spring (ft-AMSL)	Static Water Fall (ft-bmp)	Elevation Static Water Fall (ft-AMSL)
MMW004	6307.35	52.88	6254.47	53.83	6253.52
MMW006	6498.26	269.06	6229.20	269.33	6228.93
MMW007	6652.82	34.50	6618.32	41.35	6611.47
MMW008	6636.13	18.19	6617.94	25.20	6610.93
MMW009	not measured	214.75	NA	213.61	NA
MMW010	6466.44	3.47	64562.97	19.76	6446.68
MMW011	6269.06	92.00	6177.06	94.76	6174.30
MMW012	6505.03	Dry	NA	Dry	NA
MMW013	6655.17	1.93	6653.24	12.15	6643.02
MMW014	6442.38	3.18	6439.20	5.35	6437.03
MW-15A	6365.91	19.90	6346.01	22.38	6343.53
MW-16A	6342.37	5.92	6336.45	11.28	6331.09
MMW017	6314.14	41.19	6272.95	40.79	6273.35
MMW018	6460.80	8.96	6451.84	13.90	6446.90
MMW019	6255.75	11.60	6244.15	14.21	6241.54
MMW020	6533.56	287.05	6246.51	290.05	6243.51
MMW021	6443.47	214.89	6228.58	214.75	6228.72
MMW022	6640.97	209.22	6431.75	208.05	6432.92
MMW023	6266.79	108.70	6158.09	109.05	6157.74
MMW024	6702.64	NA	NA	65.22	6637.42
MMW025	6645.64	NA	NA	33.60	6612.04
MMW026	6638.72	NA	NA	287.60	6351.12
MMW027	6505.11	NA	NA	94.45	6410.66
MMW028	6316.63	NA	NA	79.18	6237.45
MMW029	6504.64	NA	NA	25.67	6478.97
MMW030	6362.90	NA	NA	25.81	6337.09
MMW031	6349.84	NA	NA	99.73	6250.11

Notes:
NA – Not Applicable (well not installed or measuring point not surveyed).
MP – Measuring Point
ft-AMSL – Feet above mean sea level
ft-bmp – Feet below measuring point

2.2.5 Work Plan Deviations

Several deviations from the *2008 Phase IIb Monitoring Well Installation Technical Memorandum* (MWH, 2008a) occurred during the 2008 field program. These deviations were due to field conditions or equipment limitations. None of the deviations are expected to have any effect on data quality or the project objectives. The notable deviations are discussed below.

2.2.5.1 MMW029 Location

The location for MMW029 had been preliminarily located in the field pending the direct-push sampling results. Once the direct-push results were reviewed and the well installation program was underway, the preliminary location was moved to an area where some of the higher selenium concentrations were observed in the alluvial system. This approach was consistent with the action identified in the interim groundwater report (MWH, 2008c). This change in the preliminary location required the A/T to be notified. This notification from MWH is contained in Appendix E.

2.2.5.2 MMW026 Completion

During construction of monitoring well MMW026, the drillers were unable to retract the 8-inch-diameter protective casing. To be compliant with the State of Idaho well completion regulations, a minimum of 18 feet of surface seal must be placed around the outer casing. Due to the need for specialized equipment to place this seal, it was not completed in 2008, but will be installed during the 2009 field season. Practically, the lack of a surface seal is not considered a concern. This is because expansive clay layers are present in the alluvium, which have been observed to swell into the drill holes. In 2007, at MMW008, there was an attempt to install 4-inch-diameter PVC well casing in an open 8-inch-diameter alluvial drill hole. Before the filter pack and seal could be placed in the drill hole, the clays had swelled in around the 4 inch PVC and temporary steel casing was required to keep the borehole open during installation. It is thought that this happened with the MMW026 casing, and in fact, may be the reason that the casing could not be extracted.

2.2.5.3 In House Well Development

MWH developed all of the 2008 Monitoring Wells with the exception of MMW026. This was to ensure the wells would be developed to allow for sampling during the Fall sampling event. MMW026 development was conducted by Independent Drilling and overseen by Monsanto Personnel under the direction of in-the-field MWH personnel.

2.2.5.4 PVC Specifications for Monitoring Wells

The monitoring well specifications contained in the well installation SOP call for Schedule 80 PVC for wells over 150 feet in depth (MWH, 2008a). This was identified as an overly conservative specification that was modified to 500 feet during the field program. A letter provided to the A/T during the field program, justifying the change, is included in Appendix

E. The need for this developed because wells were to be installed exceeding 150 feet, but less than 400 feet, and the drilling contractor did not have Schedule 80 PVC on site. Opposed to delaying the drilling program, due to the overly conservative PVC specification, a justification for changing the specification was provided, and Schedule 40 PVC was used in monitoring wells up to approximately 200 feet.

2.3 Summary of 2007 and 2008 Surface Water and Groundwater Water Quality Sampling

Long-term surface water and groundwater sampling continued in the Spring and Fall of 2007 and 2008. A summary of this effort, including analytical results, maps, and figures is included as Appendix D, *2007- 2008 Surface Water and Groundwater Water Sampling Technical Memorandum* (Sampling Technical Memorandum). In addition, groundwater quality samples were collected and analyzed for selenium as part of the direct-push sampling program. These results are summarized in this section, but the discussion of the program and detailed presentation of the results is included in Appendix A. To date, data validation is not completed, and all water quality data presented herein are considered preliminary and are presented without data qualifiers. The data presented below only include results for selenium as it is considered the primary indicator for COPC impacts in the mine areas, and is the primary concern and potential risk driver. For information and results on other COPCs, the reader is referred to the appendices.

2.3.1 Surface Water Quality Results

All surface water stations are shown on Drawing 24. Table 2-10 presents preliminary total selenium results for surface water stations from the 2008 sampling events. The data will be final once data validation is completed. These data are depicted in the spatial wire diagrams provided in the Sampling Technical Memorandum included as Appendix D.

TABLE 2-10
2008 SURFACE WATER TOTAL SELENIUM (MG/L; PRELIMINARY)

Station ID	Spring	Fall
MRV011	0.0040	0.0018
MRV016	0.0020	0.0019
MRV017	<0.0010	0.00052
MST019	0.0040	0.0017
MST020	0.0050	0.0015
MST022	0.0040	0.0015
MST023	0.0043	0.0019
MST026	0.0040	0.0016
MST027	0.0040	0.0013
MST028	0.0050	0.0014
MST044	<0.0010	0.0011
MST045	<0.0010	0.0012
MST049	<0.0010	<0.0010

TABLE 2-10 2008 SURFACE WATER TOTAL SELENIUM (MG/L; PRELIMINARY)		
Station ID	**Spring**	**Fall**
MST050	<0.0010	0.0025
MST051	Dry	Dry
MST052	Dry	Dry
MST054	<0.0010	0.0013
MST057	0.0090	0.0045
MST059	Dry	Dry
MST060	Dry	Dry
MST061	Dry	Dry
MST063	Dry	Dry
MST066	0.019	Dry
MST067	0.41	Dry
MST068	0.48	Dry
MST069	0.87	1.2
MST088	0.0070	Dry
MST089	0.0040	Dry
MST090	<0.0010	Dry
MST091	Dry	Dry
MST092	0.0070	Dry
MST093	<0.0010	Dry
MST094	<0.0010	Dry
MST095	0.23	Dry
MST096	0.031	0.030
MST101	<0.0010	0.00054
MST127	0.0050	0.0017
MST128	0.0043	0.00074
MST129	0.0070	0.0011
MST131	0.0020	0.0022
MST132	0.0040	0.0013
MST133	<0.0010	Dry
MST134	<0.0010	Dry
MST135	<0.0010	Dry
MST136	0.021	Dry
MST137	0.010	Dry
MST143	0.0023	0.0026
MST144	0.21	Dry
MST232	0.0040	0.0013
MST234	<0.0010	0.0016
MST235	<0.0010	<0.0010
MST236	<0.0010	<0.0010
MST237	<0.0010	<0.0010
MST254	<0.0010	0.00063
MST269	0.071	Dry
MST274	0.0040	0.0039
MST276	0.0050	0.0035
MST277	<0.0010	Dry
MST278	Dry	Dry
MST279	<0.0010	0.0025

TABLE 2-10 2008 SURFACE WATER TOTAL SELENIUM (MG/L; PRELIMINARY)		
Station ID	**Spring**	**Fall**
MST280	0.29	Dry

2.3.2 Groundwater Quality Results

Table 2-11 presents the total selenium results in groundwater for the 2008 events. The stations include seeps, springs, ponds, headwater streams (i.e., surface expressions of groundwater) and all wells. These results are also displayed on Drawings 25 and 26, and the comprehensive results for all COPCs are provided in Appendix D.

TABLE 2-11 2008 GROUNDWATER TOTAL SELENIUM (MG/L; PRELIMINARY)		
Station ID	**Spring**	**Fall**
MDS016	NS	Dry
MDS022	<0.0010	0.0043
MDS025	Dry	Dry
MDS026	0.19	0.019
MDS030	0.45	0.89
MDS031	0.42	0.73
MDS032	0.75	Dry
MDS033	0.66	Dry
MDS034	0.14	Dry
MSG001	0.0020	0.0024
MSG002	Dry	0.016
MSG003	0.37	0.64
MSG004	0.0050	0.014
MSG005	0.015	0.0048
MSG006	0.098	0.023
MSG007	0.020	0.013
MSG008	0.34	Dry
MSP011	0.070	Dry
MSP012	0.12	Dry
MSP013	0.16	Dry
MSP017	0.98	0.078
MSP018	0.61	0.17
MSP019	0.099	0.020
MSP020	0.067	0.026
MSP021	0.12	0.028
MSP022	0.0090	Dry
MSP031	0.0030	Dry
MSP055	0.53	Dry
MSP059	0.018	Dry
MSP062	<0.0010	Dry

TABLE 2-11 2008 GROUNDWATER TOTAL SELENIUM (MG/L; PRELIMINARY)		
Station ID	**Spring**	**Fall**
MST067	0.41	Dry
MST068	0.48	Dry
MST069	0.87	1.2
MST093	<0.0010	Dry
MST094	<0.0010	Dry
MST095	0.23	Dry
MST096	0.031	0.030
MST136	0.021	Dry
MST144	0.21	Dry
MST269	0.071	Dry
MST274	0.0040	0.0039
MST276	0.0050	0.0035
MST277	<0.0010	Dry
MST278	Dry	Dry
MST280	0.29	Dry
MAW001	0.0020	NS
MAW002	0.0020	NS
MAW003	0.0020	NS
MAW004	<0.0010	NS
MAW005	NS	0.00076
MAW006	<0.0010	NS
MAW007	<0.0010	NS
MAW008	NS	0.071
MDW001	<0.0010	NS
MDW002	<0.0010	NS
MDW003	0.0020	NS
MDW004	0.0020	NS
MDW005	0.0020	NS
MDW006	0.00042	NS
MPW019	<0.0010	0.0015
MPW022	<0.0010	<0.0010
MPW023	<0.0010	0.00065
MMW004	0.0020	0.0025
MMW006	0.069	0.071
MMW007	0.0050	0.0024
MMW008	<0.0010	0.0014
MMW009	<0.0010	0.0011
MMW010	0.10	0.018
MMW011	<0.0010	0.00088
MMW013	0.051	0.091
MMW014	<0.0010	0.0020
MW-15A	1.1	1.4
MW-16A	0.070	0.016
MMW017	0.10	0.10

TABLE 2-11 2008 GROUNDWATER TOTAL SELENIUM (MG/L; PRELIMINARY)		
Station ID	**Spring**	**Fall**
MMW018	0.027	0.027
MMW019	0.0040	0.00056
MMW020	0.010	0.0088
MMW021	0.049	0.050
MMW022	0.017	0.018
MMW023	0.0040	0.0039
MMW024	NS	0.014
MMW025	NS	0.00088
MMW026	NS	0.0013
MMW027	NS	0.31
MMW028	NS	0.0026
MMW029	NS	0.81
MMW030	NS	<0.00010
MMW031	NS	0.00087

2.3.3 Direct-Push Program Selenium Analyses

The direct-push program is summarized in Section 2.2.1. Tables 2-12 through 2-14 present the dissolved selenium results for samples collected during the program. Drawings 5 through 10 present the locations and selenium concentrations for the individual borings and Drawings 27 and 28 display the dissolved selenium isoconcentrations for the Ballard Mine area. Additional procedural information, observations, and boring logs are included in the Direct-Push Technical Memorandum in Appendix A.

TABLE 2-12 BALLARD MINE DIRECT-PUSH DISSOLVED SELENIUM (MG/L; PRELIMINARY)					
Area E		**Area F**		**Area G**	
Borehole	**Dissolved Selenium**	**Borehole**	**Dissolved Selenium**	**Borehole**	**Dissolved Selenium**
BH031	0.113	BH001	Dry	BH014	0.42
BH032/MBW032	0.63	BH002	0.4	BH015	1.22
BH033	0.014	BH003	0.096	BH016A[1] BH016B[1]	0.046 0.003
BH034	Dry	BH004	0.02	BH017	0.29
BH035	0.005	BH005	0.07	BH018	0.37
BH036	Dry	BH006/MBW006	0.34	BH019	1.32
BH037	0.002	BH007	Dry	BH020	Dry
BH038	Dry	BH008	<0.001	BH021	0.65
BH039	0.088	BH009/MBW009	0.026	BH022	Dry
BH040	0.065	BH010	0.22	BH023	Dry
BH041	0.021	BH011MBW011	0.159	BH024	0.011
BH042	0.039	BH012	0.71	BH025	0.01

TABLE 2-12
BALLARD MINE DIRECT-PUSH DISSOLVED SELENIUM (MG/L; PRELIMINARY)

Area E		Area F		Area G	
Borehole	**Dissolved Selenium**	**Borehole**	**Dissolved Selenium**	**Borehole**	**Dissolved Selenium**
BH043	0.01	BH013	1.68	BH026/MBW026	0.2
BH044	Dry	BH028/MBW028	0.62	BH027/MBW027	0.016
BH045	<0.001	BH064	0.54	BH068	0.39
BH046	<0.001	BH065	0.22	BH069	0.012
BH047	Dry	BH066	Dry	BH070	0.018
BH048/MBW048	<0.001	BH067	0.26	BH071	<0.001
BH049a	Dry	BH118	<0.001		
BH049b	Dry	BH119	0.029		
BH050	<0.001	BH120	0.082		
BH051	0.004	BH121	0.006		
BH052	0.27	BH122	0.018		
BH053	1.25	BH123	0.016		
BH054	0.43	BH124	0.014		
		BH125	0.067		

Notes:
(1) – Two samples were collected from the borehole at two different depths: BH016A at 29 ft bgs; BH016B at 38.5 ft bgs

TABLE 2-13 HENRY MINE DIRECT-PUSH DISSOLVED SELENIUM (MG/L; PRELIMINARY)			
Area C		**Area D**	
Borehole	**Dissolved Selenium**	**Borehole**	**Dissolved Selenium**
BH029	Dry	BH055	Dry
BH030	Dry	BH056	Refusal
BH072	Dry	BH057A	Refusal
BH073	0.003	BH057B	Refusal
BH074	0.031	BH058	<0.001
BH075	Dry	BH059	0.041
BH076	<0.001	BH060	Refusal
BH077	<0.001	BH061	Refusal
BH078	Dry	BH062	Refusal
BH079	<0.001	BH063	0.13

TABLE 2-14 ENOCH VALLEY MINE DIRECT-PUSH DISSOLVED SELENIUM (MG/L; PRELIMINARY)			
Area A		**Area A**	
Borehole	**Dissolved Selenium**	**Borehole**	**Dissolved Selenium**
BH080	<0.001	BH100	<0.001
BH081	<0.001	BH101	<0.001
BH082	<0.001	BH102	Dry
BH083	0.05	BH103	Dry
BH084	<0.001	BH104	Dry
BH085/MBW085	0.001	BH105	0.002
BH086	0.003	BH106	0.012
BH087/MBW087	<0.001	BH108	Dry
BH088	<0.001	**Area B**	
BH089	<0.001	**Borehole**	**Dissolved Selenium**
BH090	<0.001	BH107/MBW107	0.001
BH091	<0.001	BH109	Dry
BH092	<0.001	BH110	Dry
BH093	<0.001	BH111	Dry
BH094	<0.001	BH112/MBW112	Dry
BH095	Dry	BH113	<0.001
BH096	<0.001	BH114	Dry
BH097	<0.001	BH115	Dry
BH098	<0.001	BH116	Dry
BH099/MBW099	<0.001	BH117	0.001

2.3.4 Deviations from the Work Plan

Deviations from the surface water and groundwater sampling program during the 2007 and 2008 events include: the addition of three new stations discovered during the Spring 2008 event; a modification to field procedures at some seep stations in Spring 2008; inclusion of newly installed wells and additional existing stations; and changes to the analyte list.

Spring 2008 was unusually wet resulting in discovery of three new stations by the field teams. The stations are dump seep MDS034 and stream MST280, both at Henry Mine, and MSG008, a spring at Ballard Mine. MSG008 is a two-inch-diameter plastic pipe sticking out of the ground. Its origin is unknown. Each of these stations is considered a surface expression of groundwater (SEGW). The samples were analyzed for both the surface water and groundwater analytes in spring; however, all three stations were dry the following Fall 2008.

In addition to the discovery of new stations in Spring 2008, the wet conditions resulted in higher than typical flows at some seeps in western Ballard Mine. The drainage from the seeps is normally very low and easily captured from one channel. However, in Spring 2008 flows were wide, shallow, and diffuse; therefore the field teams installed temporary flumes to consolidate the flow. Once the flumes were installed and the sediment settled out, discharge was recorded, followed by field parameter readings and sample collection. Although, field data and sample collection were performed in reverse order of the SOP, it is not anticipated to adversely impact data quality.

Sixteen new monitoring wells were installed in 2007 and included in the sampling program in Fall 2007. An additional eight new monitoring wells were installed in Summer 2008 and first sampled in Fall 2008. Existing stations, in addition to the new wells and the stations included in the original work plan, were added to the Spring 2008 station list by the A/T. These stations include: surface water stream stations MST059, 60, and 61 at Enoch Valley Mine, and eight agricultural and six domestic wells located throughout the mine areas. The three stream stations were all found to be dry in both Spring and Fall. The wells were sampled in the Spring with exception of agricultural wells MAW005 and MAW008 which were sampled in Fall after necessary repairs had been made.

Changes to the analyte list were directed by the A/T. The analyte lists for the four events are shown in Table 2 of the Sampling Technical Memorandum included in Appendix D. These changes were made based on COPC determination and screening and for obtaining uniform temporal data between existing and newly added stations. Correspondences pertaining to A/T direction and rationale for analyte list modification are provided in Appendix E of this report.

2.4 Water Balance Model

In 2008, the key hydrological component of an overall water balance for mine sources areas was evaluated. This component is the infiltration of precipitation and the subsequent runoff and percolation through mine waste rock facilities (dumps and pit backfills) at the Ballard, Henry and Enoch Valley Mines. This evaluation is an important component of the overall water balance that will be used to compare water movement through and off of the mine waste rock source areas, source material contact water discharge from springs and dump seeps, and percolation into the groundwater systems. The water balance estimates will also be used to help characterize the mechanisms by which selenium is transported from the waste rock (either surficially or by leaching).

To address an absence of some specific site and material data and uncertainty in a number of other variables, a probabilistic modeling approach was used. The USEPAs Hydrologic Evaluation of Landfill Performance (HELP) model, Version 3.07, was used to perform the basic water balance calculations for storage, percolation, runoff and evapotranspiration associated with the mine waste rock facilities. Based upon the uncertainty and observed stochastic nature of many of the soil, vegetation, and slope characteristics on the P4 waste rock dumps, it was deemed necessary to find a way to account for the varying distributions of the input variables in the HELP model. Thus, the overall model was developed in the GoldSim modeling environment and was designed to produce both deterministic and probabilistic results; GoldSim is a probabilistic simulation program with a wide range of applications. The GoldSim model was linked to HELP through a dynamic link library (DLL) in C++, so that while the stochastic distributions could be set in GoldSim, the calculations were actually performed in the HELP model.

The result of this evaluation was that the variability associated with the assessment given the uncertainty in the input data rendered the estimates of percolation through the mine waste rock of more limited use than desired. Therefore, a detailed presentation of the data is not made herein. The estimation of percolation through the mine waste material ranged from 11.8 to 62.1 percent of precipitation. Slope, runoff area, vegetation cover and soil type were the primary variables evaluated. The average annual precipitation used in the model was 22.15 inches/year (in/yr).

To further help address uncertainty in the infiltration estimation, recommendations are included herein for collection of some additional data. The additional data that are needed to refine the water balance evaluation of the source areas include an assessment of current topographic conditions, characterization of type and relative density of vegetation cover, and an assessment of the nature and physical properties of the cover soils. As of late 2008 current topography is available for all three mine areas, so the topographic assessment of slope and runoff area can be completed. During the Spring and Fall of 2009, a soil and vegetation survey will be completed that will provide a current assessment of the vegetation and cover soil types. A recommendation is provided in Section 3.3 for some additional measurement of physical and hydrological properties of the cover soils. In addition, ongoing data collection activities at the Enoch Valley Mine, where the waste rock facilities have been instrumented to monitor infiltration, may be used to support the water balance. These detailed data are being collected for a study currently being sponsored by the Idaho Mining Association. Once reported, this data will be available to support the Mines SI. Other studies are being conducted for the permitting of the nearby Blackfoot Bridge Project, these data may also be useful in the assessment of the water balance for the mines.

2.5 General Water Quality Assessment

A general water quality assessment has been an ongoing evaluation with previous presentation of the general water quality, primarily via Piper Diagrams, in the Interim Groundwater Report (MWH, 2008c) and in the Monitoring Well Installation Technical Memorandum for 2007 (MWH, 2007b). The objective of these evaluations has been to assess if the general water quality trends can be used to indicate the providence of the waters being sampled and if any trends can be observed that may be useful in the overall characterization of the nature and extent of contamination. Previous evaluations have indicated that there is a continuum from a calcium-magnesium bicarbonate water type to a calcium-magnesium sulfate water type. A few locations, most commonly in the Henry Mine area, have a slightly higher ratio of sodium chloride. The calcium sulfate water type tends to have higher total dissolved solids and more commonly have higher selenium concentrations (with exceptions). The calcium sulfate water type is most indicative of water that has come into contact with mine waste, while the calcium bicarbonate water type is most typical of unimpacted or background groundwater quality. The 2008 general water quality data was assessed in further detail to confirm previous observations (if valid), or identify any new trends.

2.5.1 Water Typing

The chemical quality of surface water and groundwater samples collected during Spring and Fall 2008 were analyzed using graphical methods in order to characterize the water type (i.e., hydrogeochemical facies) and evaluate spatiotemporal variations in major ion chemistry (Na^+, K^+, Ca^{2+}, Mg^{2+}, HCO_3^-, CO_3^{2-}, SO_4^{2-} and Cl^-). Water flowing through an aquifer assumes a diagnostic chemical composition that varies as a function of lithology, solution kinetics, and residence time. Variations in water chemistry are commonly used to identify differences in the mineral composition of the aquifer, and to identify potential impacts that may have resulted from mineral extraction activities. Piper and Stiff diagrams were selected to evaluate spatiotemporal variations in major ion chemistry, while scatter plots were used to characterize potential relationships between concentration of dissolved selenium and sulfate.

Use of these graphical means of presentation requires that the ion balance be considered. An imbalance can skew the presentation. The balances were found to be acceptable for the presentations. Most of the samples were within +/- 5 percent (approximately 80 percent of the samples) and all except two were within +/- 10 percent. The two exceptions were dump seeps (MDS004 and MDS030) that contained a positive imbalance of cations. Given the relatively strong geochemical signature associated with these locations, the interpretation is not affected.

2.5.2 Piper Diagrams

Piper diagrams are commonly used to portray a large number of analyses and illustrate mixing relationships between different sources of water (e.g., water type). Each point on the Piper diagram represents a chemical analysis. Ion concentrations are plotted as percentages (calculated on a milliequivalent per liter basis) in two base triangles, which are then projected onto an adjacent grid. The water type can be identified based on the location with respect to defined compositional categories, as described by Freeze and Cherry (1979). Distinct zones that have cation and anion concentrations that fall within the defined categories are used to assign the water type to a hydrogeochemical facies.

Water samples collected during Spring 2008 are plotted in Figure 2-3 and categorized according to the type of monitoring station. Monitoring stations include dump seeps, groundwater (agricultural, domestic, monitoring, and production wells), springs, and springs that discharge into a streambed. The majority of samples may be characterized as calcium-magnesium-bicarbonate followed by calcium-magnesium-sulfate type waters. However, there is a variation for a subset of the calcium-magnesium-bicarbonate and mixed waters in that they contain an elevated signature of dissolved chloride. For example, MST136 and MDW006 had chloride concentrations equal to 65 and 53 mg/L, respectively. Additionally, toward the boundary between the two water types there are a large number of samples that represent intermediate compositions.

Water samples collected during Fall 2008 are plotted in Figure 2-4. The number of samples varied between the Spring and Fall, with differences attributed to cessation of spring flow during low flow conditions and the incorporation of additional monitoring stations. Overall, the same general trends in water types were observed between the Spring and Fall. Generally, the data from 2008 indicate a slightly higher proportion of sodium-chloride than in previous evaluations.

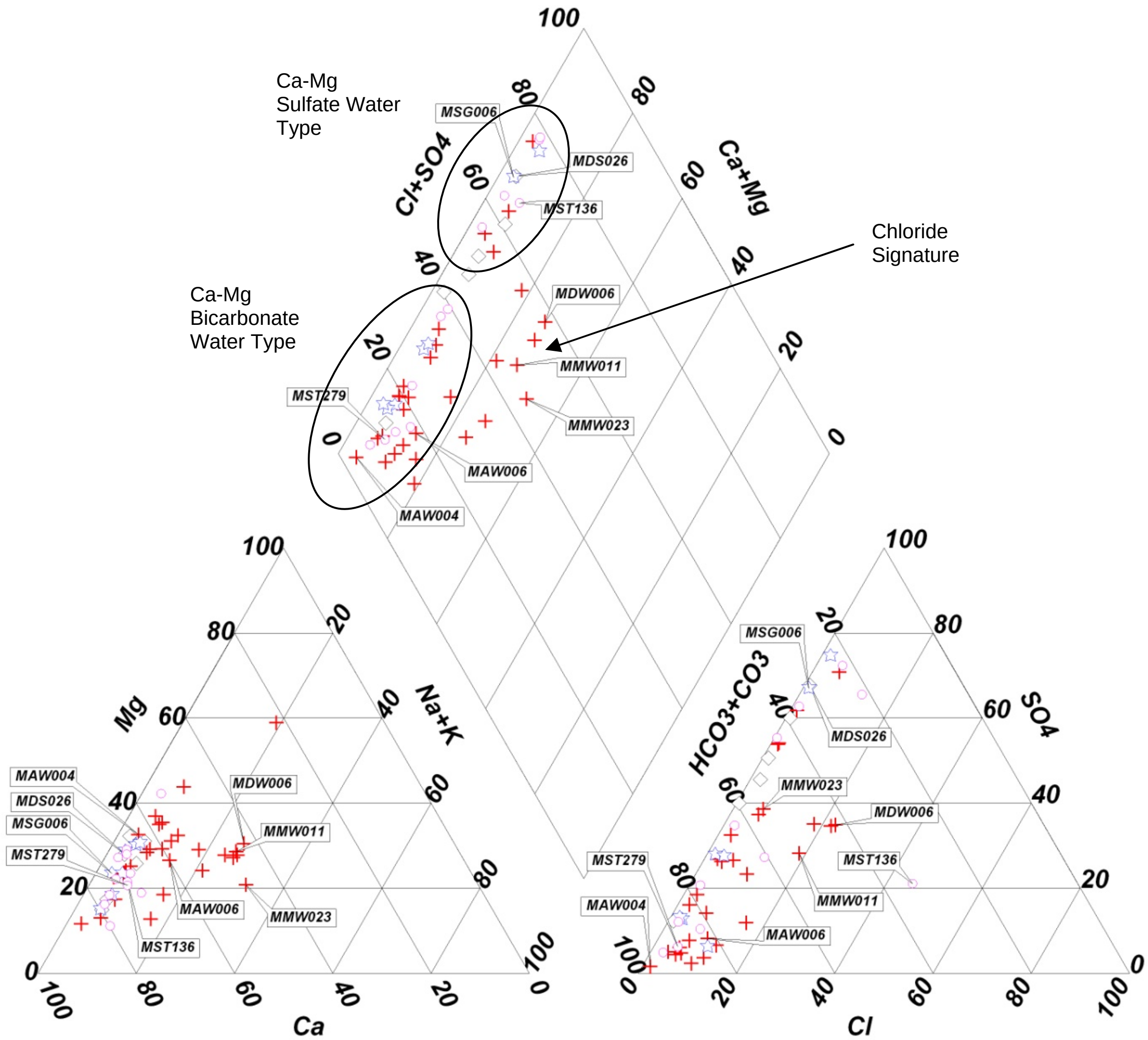

Figure 2-3, Spring 2008 Piper Diagram. Piper diagram of water samples collected during Spring 2008 categorized according to the type of monitoring station: dump seeps (black diamonds), groundwater (red plus signs), springs (blue stars), and springs that discharge in a streambed (pink circles).

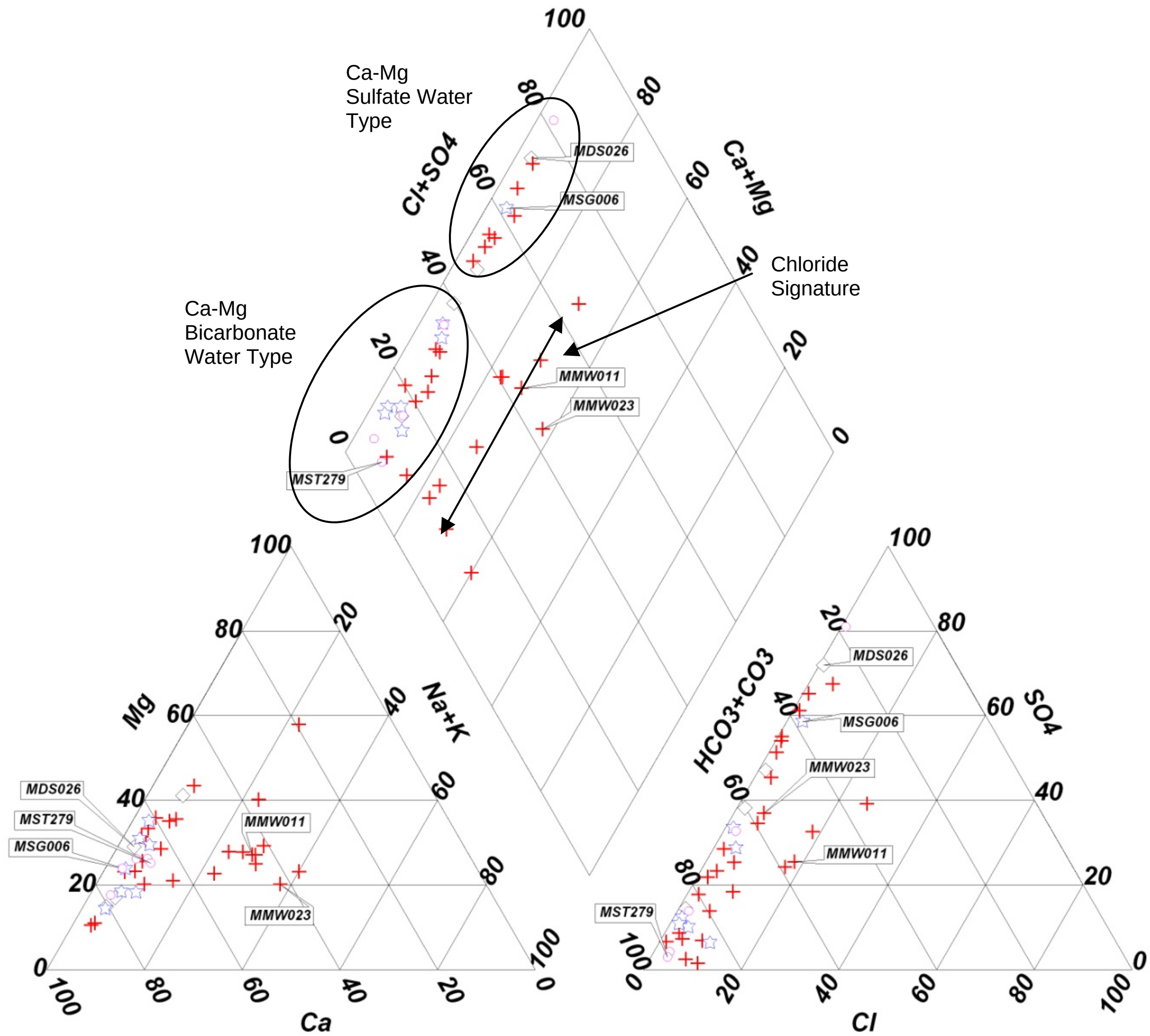

Figure 2-4, Fall 2008 Piper Diagram. Piper diagram of water samples collected during Fall 2008 categorized according to the type of monitoring station: dump seeps (black diamonds), groundwater (red plus signs), springs (blue stars), and springs that discharge in a streambed (pink circles).

2.5.3 Stiff Diagrams

Stiff diagrams are commonly used to identify water samples that have similar compositions, and to evaluate seasonal changes in water chemistry. Groundwater that is collected at depth or discharged to the surface will obtain a unique chemical signature for that location, which can be graphically illustrated with a Stiff diagram. Cations and anions are plotted in milliequivalents per liter on the left and right of the zero axis, respectively. A larger polygon area corresponds to a greater concentration of dissolved solids.

Stiff diagrams for spring and fall 2008 groundwater monitoring stations are presented in Drawings 29 and 30, respectively, and Stiff diagrams for four sampling stations are plotted in Figure 2-5 in order to portray seasonal variations in water chemistry. The diagrams provided on Drawings 29 and 30, also provide a relative assessment of selenium concentration. It is observed that samples with a high proportion of sulfate (see MDS026, Figure 2-5 for example) generally are associated with stations with higher selenium. Higher sulfate waters are generally located in the Ballard Mine area with a couple locations in the Enoch Valley Mine area.

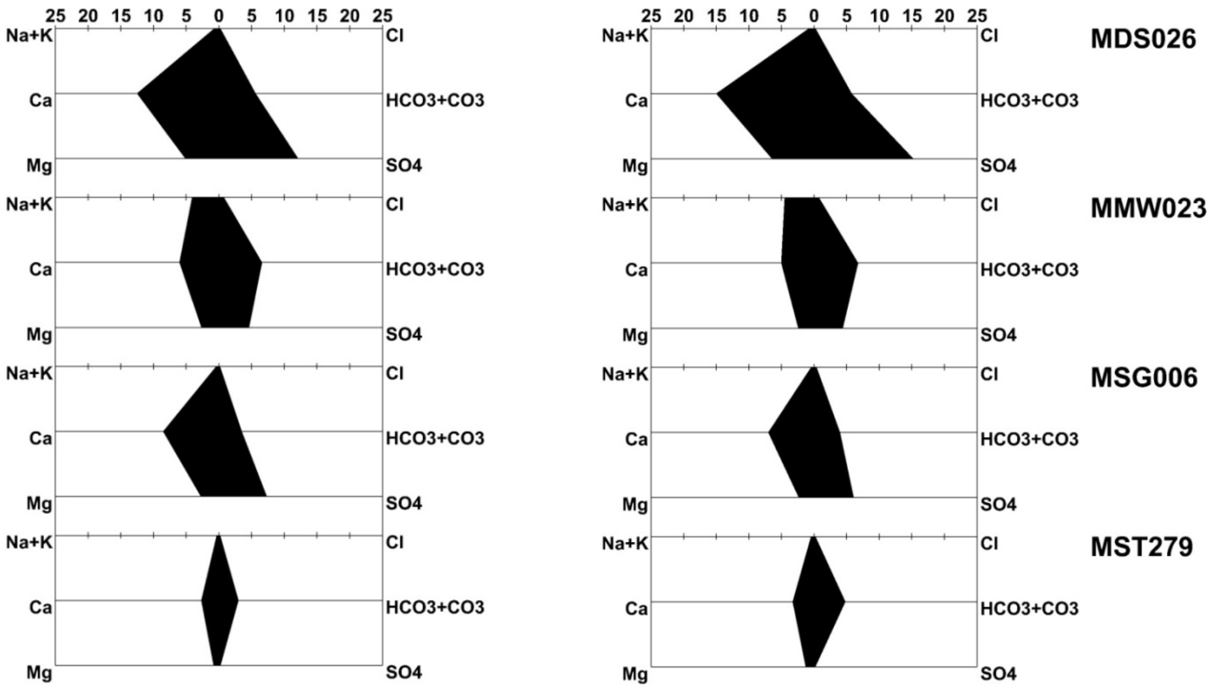

Figure 2-5, Seasonal Comparison with Stiff Diagrams. Stiff diagrams for four different monitoring points sampled during Spring (left side) and Fall of 2008 (right side). Stations MDS026 (dump seep) and MST279 (spring discharging in streambed) illustrate seasonal variations in water chemistry, while stations MMW023 (monitoring well) and MSG006 (spring) do not exhibit chemical variations through time.

Temporal variations in water chemistry can often be attributed to changes in discharge for surface water features; for example, increased discharge during spring runoff may result in decreased solute concentrations. Station MDS026 illustrates the time-dependent shape of a stiff diagram that characterizes water with elevated sulfate, which may be attributed to the oxidation of pyrite and release of sulfate within the circumneutral environment of the mine dump. Variations in water chemistry that may result from different mixing relationships are illustrated in Figure 2-6. Station MAW004 represents a water type with elevated concentrations of calcium and bicarbonate, while station MAW006 contains low concentrations of calcium and bicarbonate. Stations MMW011 and MMW023 illustrate the shape of a stiff diagram with elevated concentrations of chloride. Station MDS026 on Figure 2-5 is typical of the calcium sulfate water type often observed in association with the mine waste rock.

2.5.4 Scatter Plots

Scatter plots are commonly prepared to assess relationships between different variables. Numerous solutes and solute ratios were plotted against dissolved selenium. Sulfate was the only dissolved species that had a pronounced correlation with concentrations of dissolved selenium. Only censored data are reported, which includes measurements that were greater than or equal to the method detection limit (MDL). The MDL during Spring was 0.001 mg/L, while the MDL during Fall was 0.0005 mg/L.

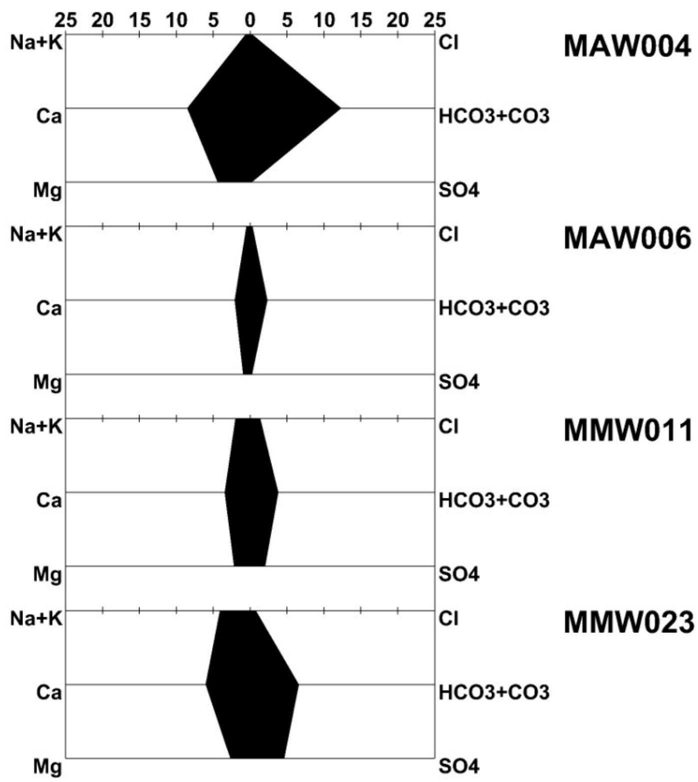

Figure 2-6, Water Quality Variability Illustrated with Stiff Diagrams. Stiff diagrams for four different groundwater monitoring points sampled during Spring 2008. Mixing between different types of water results in a unique shape for each Stiff diagram.

Dissolved sulfate and selenium for surface water monitoring stations (dump seeps, springs, and springs that discharge into a streambed) sampled during Spring and Fall 2008 are plotted in Figure 2-7. The samples are categorized according to mine site (Ballard, Enoch Valley, and Henry Mines), and are plotted on a log-log scale in order to portray the apparent correlation. Twenty-one out of 26 stations exceeded the surface water criteria for selenium (0.005 mg/L), with 15 exceedances occurring at the Ballard Mine and 4 at the Enoch Valley Mine. Two out of 21 stations had an exceedance during Spring, with the Fall concentration occurring slightly below the standard (0.0046 mg/L for MSG005 and 0.0038 mg/L for MST276). Station MDS022, which was only sampled during Fall, also had a selenium concentration measured slightly below the standard (0.0045 mg/L); station MDS022 was the only dump seep that did not exceed the surface water criteria for selenium.

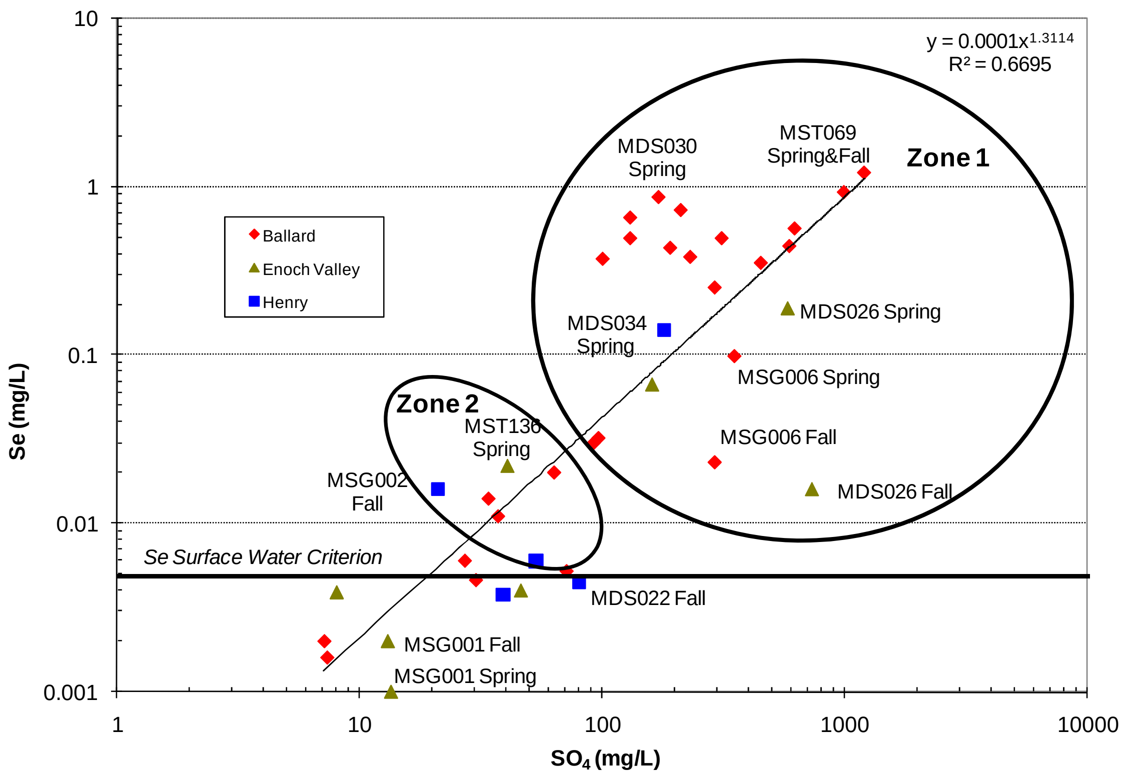

Figure 2-7, Selenium-Sulfate Scatter Plot for Surface Expressions of Groundwater. Scatter plot of dissolved selenium (Se) and sulfate (SO_4) measured during Spring and Fall 2008 at surface water monitoring stations (dump seeps, springs, and springs that discharge into a streambed). Only data above the method detection limit are shown.

Approximately two-thirds of the variation in selenium concentration can be explained by a power relationship to changes in sulfate concentration. In addition, two distinct selenium-sulfate populations are evident in Figure 2-7: waters that contain low sulfate-high selenium and waters that contain high sulfate-high selenium. Fewer samples also have higher sulfate with relatively low selenium. Processes that may be responsible for these relationships are supported by the hydrogeochemical conceptual model discussed in previous reports (e.g., MWH, 2008c). However, biologically-mediated attenuation of selenium, differences in initial sulfur-selenium ratios, and sources other than sulfide oxidation alone may all relate to the different selenium/sulfate ratios observed.

Dissolved sulfate and selenium for groundwater monitoring stations (agricultural, domestic, monitoring, and production wells) sampled during Spring and Fall 2008 are plotted in Figure 2-8. The samples are categorized according to mine site (Ballard, Enoch Valley, and Henry Mines), and are plotted on a log-log scale for comparison to the surface water monitoring stations. Six out of 29 stations exceeded the primary drinking water standard for selenium (0.050 mg/L), with three exceedances occurring at the Ballard Mine and two at the Enoch Valley Mine. One out of the six stations had an exceedance during Spring, with the Fall concentration measured below the standard (0.019 mg/L for MMW010). The selenium concentration measured at MMW010 during the Fall was significantly lower than the concentration measured during Spring (0.10 mg/L). The Spring 2008 sampling event may be anomalous since the Fall 2007 sampling event was reported at the level of detection. Station MMW021 during Spring and Fall had selenium concentrations that were measured slightly below the standard (0.048 and 0.049 mg/L respectively). Five out of 29 stations exceeded the secondary drinking water standard for sulfate (250 mg/L) (seven exceedances total), with two occurring at the Ballard Mine and one at the Enoch Valley Mine. One out of the five stations had an exceedance during Spring, with the Fall concentration measured slightly below the standard (240 mg/L for MMW022).

Compared to the surface water monitoring stations (surface expressions of groundwater), the groundwater samples did not exhibit a pronounced correlation between selenium and sulfate. The apparent disparity could be attributed to geochemical differences (e.g., redox or mass of adsorbate such as hydrous ferric oxide present in the aquifer sediments) between surface and groundwater samples. The various processes discussed above may have more pronounced roles in the more anoxic groundwater environment.

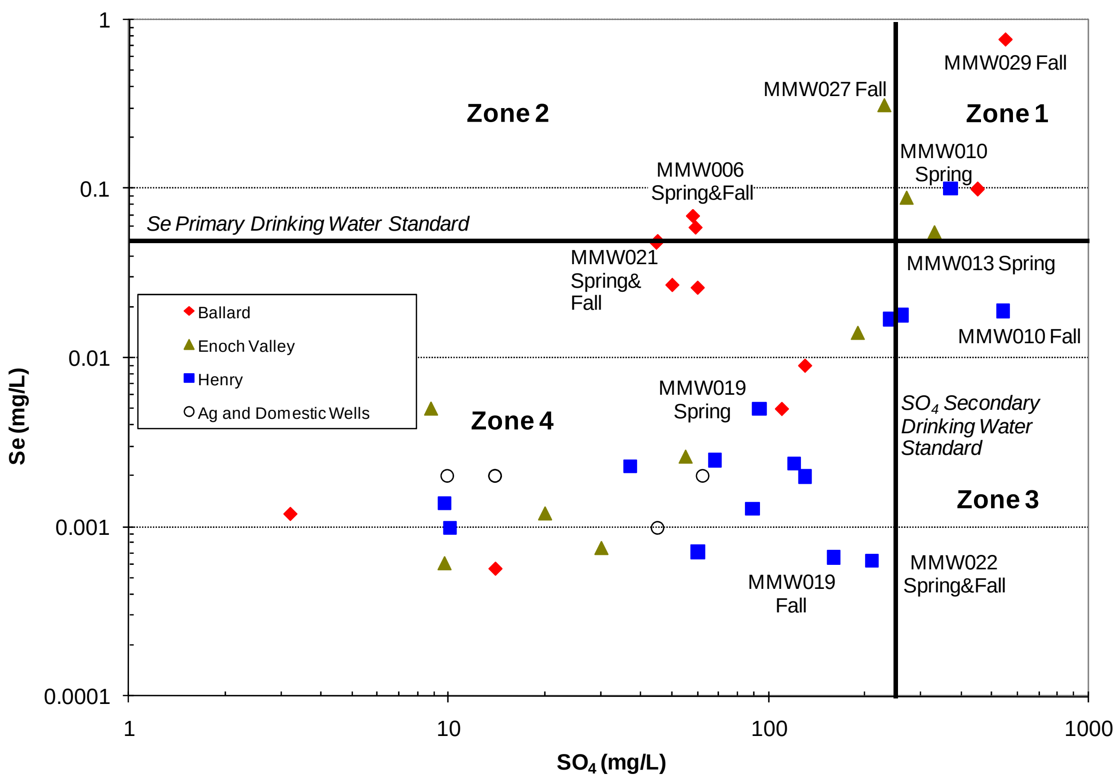

Figure 2-8, Selenium-Sulfate Scatter Plot for Groundwater. Scatter plot of dissolved selenium (Se) and sulfate (SO_4) measured during Spring and Fall 2008 at groundwater monitoring stations (agricultural, domestic, monitoring, and production wells). Only data above the method detection limit are shown.

3.0 UPDATED DATA GAP EVALUATION

This section discusses the data that were collected to fulfill each of the data gaps discussed in Section 1.2. An assessment was made as to whether data gaps had been completely or partially addressed, or if new data gaps have been identified. Identification of a new data gap could also occur if a conceptual model is refined as the result of new data. Subsequent to the data gap analysis, any remaining data gaps are presented and discussed, and proposed actions to address any of the remaining data gaps are also presented.

3.1 Data Gap Analysis

The bulk of the data gaps addressed in 2008 (and 2007 in some cases) were associated with the hydrogeologic characterization. However, three other related but separately identified data gaps were also identified. These are also included in the data gaps assessment and consist of:

- Improved mapping including mass wasting survey information and dump and pit areas and volumes (waste rock pile boundaries adjusted appropriately)
- Water balance assessment
- General water quality typing evaluation

The results for these additional analyses have been presented in Section 2.

Surface water data have been presented, but these data were collected largely to support the general surface water characterization, and in support of the groundwater characterization. The surface water data were collected during a similar period as the groundwater data in 2007 and 2008, and therefore, provided a snapshot of the entire hydrological system.

3.1.1 Hydrogeologic and Groundwater Characterization

The hydrogeologic data gaps as defined in the 2007 Hydrogeologic Report (MWH, 2008c) are presented in Tables 3-1, 3-2, and 3-3, which have been updated to include the results from the 2008 groundwater investigation activities. These tables include both the data gaps evaluated in 2008, as well as sources and pathways previously evaluated (MWH, 2008c), and are intended to accompany and summarize the text in this section. For completeness, all potential pathways evaluated in 2007/2008 are included in the tables regardless of whether or not data gaps were identified. Each of the three hydrogeologic systems investigated are described in this section for each of the three mines. All of the hydrologic data gaps indentified in 2007/2008 were addressed. The majority of the potential groundwater pathways evaluated were completely characterized; however, several require further characterization. The following discussion focuses on selenium as the key indicator parameter and as the likely primary risk driver. However, the SI and risk assessment will need to address all of the COPCs. The complete data set for 2007 and 2008 for groundwater is provided in Appendix D.

3.1.1.1 Alluvial Groundwater System

Alluvial groundwater was characterized using monitoring wells and a direct-push sampling program. It should be noted that while the term *alluvial groundwater system* is used, it is used to generally describe the local near-surface groundwater system within alluvium, as well as other surficial deposits such as colluvium and even weathered bedrock. The direct-push sampling program was the key component in the evaluation of the alluvial groundwater system in 2008. This program is summarized in Section 2.2.1 with details presented in Appendix A (i.e., Direct-Push Technical Memorandum). The direct-push program focused on selenium as the expected primary risk driver at the mine sites, and as a primary indicator for the presence of other COPCs. The criteria generally considered for plume closure is the State of Idaho groundwater standard for selenium of 0.05 mg/L. However, it is also recognized that where groundwater discharge to surface water is possible, the fresh water aquatic criteria of 0.005 mg/L may be relevant.

All three mines were addressed by the direct-push program, with much of the focus at the Ballard Mine. At the Ballard Mine, alluvial flow systems are present on the eastern and western sides of the mine. Per the conceptual models presented in MWH (2008c), waste rock placed in headwater areas along the perimeter of the alluvial areas could act as a source of selenium and other COPCs (see Section R, Drawing 16, for example).

The results of the direct-push program in the Ballard Mine area are presented in Appendix A. Drawings 27 and 28 present selenium isoconcentration maps for the eastern and western Ballard Mine areas, respectively (based on direct-push, well, and spring data), and the data with respect to the data gaps is summarized in Table 3-1. Table 3-1 also includes data from other relevant alluvial sampling locations.

As illustrated on Drawings 27 and 28, coherent selenium plumes occur on both sides of the mine. Selenium plumes in shallow groundwater have been identified from two waste rock dumps on the east side of the Ballard Mine. Elevated selenium concentrations are identified by three direct-push boreholes associated with mine dump MWD084 (Drawing 27). Two separate selenium plumes are evident from mine dump MWD082. The northern of the two plumes is identified using data from eleven direct-push boreholes. The southern plume is identified using data from five direct-push boreholes. The downgradient edge of the plume originating from MWD084 is bounded by direct-push boreholes BH050 and BH051, with selenium concentrations of <0.001 and 0.004 mg/L, respectively. The plumes originating from MWD082 are bounded on their downgradient ends by boreholes BH041, BH042 and BH043 with selenium concentrations of 0.021, 0.039, and 0.010 mg/L. While these concentrations are below the Idaho groundwater standard of 0.05 mg/L, they do not indicate that the edge of the plume has been confirmed.

The alluvial selenium groundwater plumes on the western side of the Ballard Mine appear to largely originate from waste rock dumps MWD080 and MWD081 (Drawing 28). The plume originating from MWD080 appears relatively broad, but does not appear to have migrated very far downgradient in the alluvial system. This could be due to the relatively flat hydraulic gradients in this area, as the area lies approximately on the drainage divide between the Little Blackfoot and Blackfoot Rivers, to the north and south respectively. The topography indicates that the majority of MWD080 is in the Little Blackfoot River watershed. The apparent downgradient edge of this plume is bounded by selenium concentrations of <0.001, 0.011, 0.012 and 0.018 mg/L in boreholes BH071, BH024, BH069 and BH070, respectively.

A bedrock hill is present adjacent to MWD081, and the plumes originating from MWD081, and the southern part of MWD080, are migrating in the alluvial groundwater system on either side of the hill. These two plumes turn southward to the Blackfoot River and merge (Drawing 28). Borehole BH125 appears to be located in the most downgradient location and had a selenium concentration of 0.067 mg/L. This plume is not considered bounded in the downgradient direction.

In the Ballard Mine area, several of the direct-push boreholes were completed as monitoring wells. These include six locations on the west side of the Ballard Mine, and two locations on the east side. These wells, along with other existing wells and springs, will continue to be used to evaluate changes in the plume chemistry and concentrations of other COPCs.

The local alluvial groundwater system data gaps in the Henry Mine area are summarized on Table 3-2. The local alluvial groundwater system was evaluated in two general areas at the Henry Mine. These areas are primarily located in alluvial areas between the north and central Henry mine pits near the Little Blackfoot River, and between the south and central pits in headwater areas of Lone Pine and Long Valley Creeks. The sampling locations and results for the direct-push sampling in these two areas are shown on Drawings 7 and 8, respectively. Other groundwater data from 2008 are presented on Drawing 26. Generally, data in these areas was not conducive to contouring because of limited numbers of sample results above selenium detection limits. This is also in part due to that fact that extensive alluvial deposits are not present in the Henry Mine area (e.g., compared to the Ballard Mine area).

An alluvial groundwater system was identified in three direct-push boreholes south of the Little Blackfoot River along the edge of waste rock dump MWD088. Concentrations in these boreholes ranged from <0.001 to 0.13 mg/L in BH058, BH059 and BH063. Concentrations on the northern edge of MWD088 near the Little Blackfoot River were <0.001 and 0.041 mg/L. Other shallow monitoring wells in this area MMW004 and MMW019, also indicate low levels of selenium (Drawing 26). Dump seeps and springs sampled right at or on the waste rock dumps, however, contained selenium levels that were elevated (see MDS034 and MST280, with selenium concentrations of 0.14 and 0.29 mg/L, respectively, in the Spring of 2008; Drawing 26). No flow was observed at these discharge locations after the Spring 2008 event. In the area north of the Little Blackfoot River (Drawing 7, Boreholes BH55 – BH57A), an alluvial groundwater system was not located. The data from the northern Henry Mine area indicate that the alluvial system is of limited extent, but may be slightly impacted near the waste rock. The majority of the elevated selenium loading appears to be associated with seasonal discharges that come directly from the waste rock dumps.

The direct-push program and monitoring well sampling in the area between waste rock dumps MWD086 and MWD090 on the south end of the Henry Mine has not indicated any selenium impacts to the alluvial groundwater system beyond the extent of the waste rock areas. Within the waste rock area, MMW010 has exhibited variable selenium concentrations ranging from less than 0.001 mg/L to 0.10 mg/L in 2007 and 2008 (Drawing 26), and BH074 contained a selenium concentration of 0.031 mg/L (Drawing 7).

The local alluvial groundwater system was evaluated in two general areas at the Enoch Valley Mine, in the west of the northern portion of the mine (northern end of MWD091), and in the southern mine area (around MWD092) (Table 3-3). These correspond to areas A and B of the direct-push investigation (Drawings 9 and 10). Elevated selenium concentrations have only been identified locally in the Enoch Valley mine areas.

In the northern area of the Enoch Valley Mine, the relevant alluvial groundwater system lies to the west of the northern portion of MWD091. Monitoring well MMW012 was installed into the alluvium to near the top of the underlying bedrock. The well has been dry since installation, and seven of ten direct-push locations in the alluvial system were also dry in 2008. At three of the locations where water was encountered, the dissolved selenium concentrations were 0.001 mg/L or not detected at 0.001 mg/L (Drawing 9).

In the southern portion of the Enoch Valley Mine, water was encountered in a much higher percentage of the boreholes, but dissolved selenium concentrations were similarly low (generally less than 0.003 mg/L) (Drawing 10). Two exceptions were present, direct-push boreholes BH083 (0.05 mg/L dissolved selenium) near monitoring well MMW024, and BH106 (0.012 mg/L) near pond MSP022. Monitoring well MMW013 located near BH083, installed in the uppermost weathered Dinwoody Formation, also contained total selenium concentrations of 0.051 and 0.091 mg/L in the Spring and Fall of 2008, respectively (Drawing 26). Pond MSP022 near BH106 had a measured total selenium concentration of 0.009 mg/L in the Spring of 2008, and was dry in the Fall. The next locations downgradient of both of these locations contained dissolved selenium at or below the detection limit of 0.001 mg/L.

These localized areas are in contrast to the area of the southeast end of MWD092, where the alluvial groundwater contained a maximum concentration of 0.003 mg/L dissolved selenium. Monitoring wells MMW007 and MMW008 are also installed at or are in the weathered Dinwoody Formation. The maximum concentration measured in these wells was 0.0050 mg/L in 2008 (Drawing 26).

3.1.1.2 Intermediate Dinwoody and Thaynes Formations Groundwater System

The Dinwoody and Thaynes Formations represent potential intermediate groundwater flow systems in the P4 mine areas. Generally, only the Dinwoody Formation is in locations that could result in contamination from mine-related sources. Five new monitoring wells were installed into the Dinwoody Formation in 2008. There was one monitoring well installed at the Ballard Mine, one at the Henry Mine, and three at the Enoch Valley Mine. These wells were installed to address a conceptual model and data gap where waste rock setting on areas of Dinwoody Formation outcrop could act as a source, as the Dinwoody Formation is the groundwater transport pathway for COPCs (Table 3-1, 3-2 and 3-3).

At the Ballard Mine, the Dinwoody Formation is located primarily south and east of the mine. The exposures south of the mine form a highland area and are not expected to receive groundwater flow from the Ballard Mine area. However, the Dinwoody Formation present east of the mine occurs at a lower elevation in the adjacent valley, and alluvial groundwater in this area has been found to contain elevated concentrations of selenium as part of the alluvial investigation conducted in 2008 (discussed above).

One monitoring well was installed in the Dinwoody Formation to the east of the mine in 2007; although, this well (MMW018) was installed in the uppermost portion of the formation and it may be transitional to the overlying alluvial unit. The selenium concentration in MMW018 was 0.027 mg/L in both the Spring and Fall 2008 sampling events (Drawing 25). The goal of the new monitoring well installed in 2008 (MMW029) was to address flow within the Dinwoody Formation that may be isolated from the overlying alluvium. This was done at a location just off of the edge of mine waste dump MWD082 with monitoring well MMW029 (see Section S, Drawing 17). A selenium concentration of 0.81 mg/L was measured in the Fall 2008 groundwater sample collected from the well. This suggests that the Dinwoody Formation to the east of the Ballard Mine is a groundwater flow pathway with the ability to transport COPCs from source areas into the surrounding groundwater flow system. The postulated flow direction is down geologic dip to the southwest, but may also be contained only in the upper, near-surface weathered and fractured portion of the unit.

The new monitoring well installed at the Henry Mine (MMW028) and a monitoring well installed in 2007 (MMW022) had a similar objective as that of MMW029 at the Ballard Mine. Monitoring well MMW022 was installed in 2007 on the eastern edge of MWD086 (Drawings 12 and 26; and MWH, 2008c). The conceptual model was that flow in the Dinwoody Formation would be to the northeast along the general direction of the geologic dip and toward Lone Pine Creek. Selenium was detected in monitoring well MMW022 after installation, and was again measured at 0.017 and 0.018 mg/L in the Fall and Spring of 2008 (Drawing 26). While the State groundwater standard was not exceeded, this indicated that the Dinwoody Formation was a potential pathway to be further evaluated.

Two actions were undertaken at the Henry Mine to further characterize the potential intermediate Dinwoody Formation groundwater system. A spring and seep survey was conducted in the drainage to the northeast of MMW022 leading toward Lone Pine Creek. No springs were located. The second action was designed to address potential groundwater flow in the Dinwoody Formation along strike toward the Little Blackfoot River (see Section V, Drawing 20). To address this conceptual pathway, monitoring well MMW028 was installed between waste rock dump MWD088 and the Little Blackfoot River (Drawings 12 and 26). The selenium concentration detected in MMW028 during the Fall 2008 sampling event was relatively low at 0.0026 mg/L. This suggests that while there may be some connection along strike in the Dinwoody Formation to potential sources, this pathway is not currently transporting selenium and other COPCs at any significant levels.

Three monitoring wells were installed in the Enoch Valley Mine area to address the intermediate Dinwoody Formation groundwater system. These wells included MMW024 on the southern portion of the mine on the southwest side of mine waste dump MWD092, MMW025 on the southeast end of the mine, and MMW027 on the northwest end (Drawing 12).

Consistent with the other monitoring wells on the southeast end of the mine (e.g., MMW007 and MMW008) and the direct-push results, MMW025 contained a relatively low selenium concentration of 0.00088 mg/L (Fall 2008, Drawing 26). While dump seep MDS026 has had selenium concentrations exceeding 0.10 mg/L, groundwater in this area does not appear to be impacted. Either hydrogeologic conditions or geochemical conditions are limiting the transport of selenium in this area.

Monitoring well MMW024 was installed into the Dinwoody Formation adjacent to MWD092 to test the conceptual flow pathway down geologic dip in beds that may outcrop beneath the waste rock dump (see Section K, Drawing 22). Some limited impact is indicated in the Dinwoody Formation at this location, with selenium measured at 0.014 mg/L during the Fall 2008 sampling event (Drawing 26).

Monitoring well MMW027 was installed in the northwestern portion of the Enoch Valley mine area to characterize the potential Dinwoody Formation flowpath. This well was installed below a large area of waste rock that sets in a relatively steep swale (see Section L, Drawing 23). Conceptually, the MMW027 location is set in a worst case location. In addition, the investigation of the alluvium in this area generally indicates that the alluvial system does not contain water. This indicates that the uppermost groundwater system is largely in the Dinwoody Formation. The selenium level measured in MMW027 of 0.31 mg/L in the Fall of 2008 (Drawing 26) suggests that this is a potential flowpath that requires further characterization.

The apparent impacts to the Dinwoody Formation suggest that the hydraulic conductivity is relatively high. Hydraulic testing of wells installed in the Dinwoody Formation has indicated hydraulic conductivities ranging from 10^{-4} to 10^{-2} cm/sec. Given that the Dinwoody Formation is dominated by mudstones, much of this conductivity is likely due to secondary fracture permeability, which may be more open under lower lithostatic pressures near the ground surface.

In general the data gaps identified in Tables 3-1, 3-2, and 3-3 were addressed in 2008. However, there is the need for some further characterization in some areas where elevated concentrations of selenium were identified.

3.1.1.3 Regional Wells Formation Groundwater System

Nearly all groundwater monitoring wells, installed in the Wells Formation, do not contain selenium elevated above the Idaho groundwater standard of 0.050 mg/L. The one exception is in monitoring well MMW006 installed on the south edge of the West Ballard Pit (MMP035). In 2008, the selenium concentrations in MMW006 were 0.069 and 0.071 mg/L in the Spring and Fall, respectively. The monitoring well on the west side of MMP035 (MMW021), was either at or approaching the standard, with concentrations of 0.049 and 0.050 mg/L in the Spring and Fall of 2008, respectively.

Several data gaps associated with the regional groundwater flow system in the Wells Formation were addressed by additional monitoring wells in 2008 (see Tables 3-1, 3-2 and 3-3). In the Ballard Mine area the 2008 activities focused on the Wells Formation to the west of the mine. Postulated flowpaths from impacted alluvium and along structural features were addressed. In addition, through the ongoing monitoring of water levels in the six Wells Formation monitoring wells in the west Ballard Mine area (including MMW001), the degree of hydraulic connection between individual faulted blocks ("compartment") can be evaluated.

The Wells Formation monitoring wells installed in the west Ballard Mine area in 2008 included MMW030 and MMW031. MMW030 was intended to address both the potential alluvium to Wells Formation flow pathway, as well as the potential structural pathway along the southern edge of the mine. MMW030 was installed in an area of alluvial groundwater with elevated selenium (up to 1.2 mg/L in MST069, Drawing 25). In addition, the well encountered a fault in the bottom of the drill hole between the Wells Formation and Phosphoria Formation (see Section U, Drawing 18). Selenium was not detected in groundwater collected from MMW030 during the Fall 2008 sampling event.

Monitoring well MMW031 was installed near the toe of waste rock dump MWD080 at the Ballard Mine. The well was drilled through alluvium into the Wells Formation. Direct-push boreholes in similar locations along MWD080 exhibited selenium concentrations ranging from 0.37 to 1.32 mg/L (see Drawing 6). The selenium concentration in the groundwater from well MMW031 was measured at 0.00087 mg/L in the Fall 2008 sampling event.

No additional Wells Formation monitoring wells were installed in the Henry Mine area in 2008, and the existing wells continue to indicate low selenium concentrations (less than 0.0050 mg/L). Monitoring of water levels in the two Wells Formation monitoring wells in the northern portion of the Henry Mine were to be used to help confirm the general conceptual northwestern flow direction in the regional groundwater system. Flow to the northwest toward the Henry Spring is supported by the water levels. The water level in MMW011 south of the Little Blackfoot River was 6182.46 ft-AMSL, while the water level in MMW023 north of the river was 6163.85 ft-AMSL in the Fall of 2008 (see Drawing 14). This indicates an 18.61 foot head difference between the two wells with an apparent northwestward hydraulic gradient of 0.004. Ongoing water level monitoring will be used to address the hydraulic connection between these two wells across a possible structure in the gap through which the Little Blackfoot River flows (Drawing 14).

One additional monitoring well (MMW026) was installed into the regional Wells Formation groundwater system in the southern end of the Enoch Valley Mine area. The well was designed to be a companion well to MMW009, which is located in the northern portion of the mine. This way, whether groundwater flows in the Wells Formation to the northwest or southeast along the formation strike, a monitoring well is in the probable flowpath. The selenium concentration in the groundwater sample collected from MMW026 in the Fall of 2008 was 0.0013 mg/L, compared to 0.0011 in MMW009 for the same period (Drawing 26).

In general, the Wells Formation does not appear to be a significant pathway. Long-term water level monitoring will help define the extent to which the Wells Formation is compartmentalized in the Ballard Mine in particular, and specific hydrologic gradients in the Henry and Enoch Valley Mines. Review of the data presented in Appendix D suggest selenium is not a parameter that commonly exceeds water quality standards in the Wells Formation.

3.1.2 Surface Water Quality Characterization

At this time, significant data gaps associated with the surface water characterization have been addressed and further data for characterization and risk assessment are not needed. However, continued data collection from a more limited number of key sampling stations is needed to document temporal trends and any change in conditions in the intervening time until the SI is completed for all media. This program will be documented in a new field sampling plan submitted to the A/T for surface water for 2009 and 2010.

3.1.3 Miscellaneous Data Gaps

A key component of an overall water balance for mine areas is the estimation of the distribution of precipitation that falls on the source areas. Work conducted in 2008 indicated that additional data are required to complete this analysis with a sufficient level of accuracy to provide meaningful results. This evaluation is an important component of the overall water balance that will include water movement through and off of the mine waste rock source areas, discharge from springs and dump seeps, and percolation to the groundwater systems. The water balance estimates will also be used to help characterize the mechanisms by which selenium is transported from the waste rock, either surficially, or by leaching.

As discussed in the preceding sections, groundwater impacts from elevated levels of COPCs, notably selenium, are apparent in the local alluvial and intermediate Dinwoody Formation groundwater flow systems. Due to the extent, depth and physical characteristics of these groundwater systems, remediation of groundwater may be impractical, particularly in the deeper Dinwoody Formation. Therefore, an evaluation of the subsurface material’s ability to naturally attenuate elevated concentrations of selenium (and other COCs) in the groundwater systems will be needed.

3.2 Summary of Remaining Data Gaps

In 2008, substantial progress was made in addressing identified data gaps and evaluating conceptual contaminant transport pathways. However, as expected, some data gaps remain that will need to be addressed. The majority of these are associated with the hydrogeological characterization.

3.2.1 Hydrogeologic Data Gaps

The remaining hydrogeologic data gaps are summarized in Tables 3-1, 3-2, and 3-3 for the Ballard, Henry and Enoch Valley Mines, respectively. The key data gaps are discussed below for each of the mines.

Ballard Mine

The direct-push groundwater sampling program identified groundwater selenium plumes in the shallow alluvium on the east and west sides of the Ballard Mine. The eastern plumes are generally defined by the 2008 direct-push sampling, and only limited sampling is needed to fully define the plume.

On the western side of the Ballard Mine, the northern plume in the shallow alluvium appears to be nearly defined, though a limited number of direct-push boreholes are needed to complete this characterization and define the boundaries in the western and southern directions.

The Dinwoody Formation on the eastern side of the Ballard Mine was found to contain elevated concentrations of selenium. The vertical and lateral extent of the elevated selenium levels in this pathway has not been characterized.

At this time, no further data gaps have been identified in the regional Wells Formation groundwater system at the Ballard Mine. However, ongoing water level monitoring will be utilized to help address the hydraulic connections between blocks of Wells Formation in the mine area that are separated either by faulting or by bedding. Resolution of possible inaccuracies in the survey data (different vertical datums) is also required to allow for a more detailed evaluation of the piezometric conditions in the Wells Formation.

Henry Mine

There is some suggestion of selenium-impacted groundwater in the limited alluvial system north of waste rock dump MWD088 near the Little Blackfoot River. Additional direct-push data may be warranted to confirm the limited extent of a potential impact to the alluvial system in this area, if present.

Monitoring well MMW010 and one direct-push borehole indicate the occasional presence of selenium in the alluvial groundwater in the southern portion of the Henry Mine in the waste rock area. However, 2008 data from outside the waste rock area indicate a limited alluvial system or selenium below detection limits. Given that the majority of data in this area indicate very low selenium levels, continued monitoring of MMW010 is sufficient to address this area.

Concentrations of selenium in the Dinwoody Formation in the Henry Mine area along potential flowpaths have been relatively low and below the Idaho groundwater rule standard of 0.05 mg/L (also the Federal Maximum Contaminant Level or MCL). Continued monitoring will be needed to further define the levels of COPCs in the Dinwoody Formation; however, no further data gaps have been identified.

Similar to the Dinwoody Formation, levels of selenium in the Wells Formation have not indicated a significant groundwater impact from the Henry Mine area. Piezometric data support the conceptual groundwater flow model of flow toward the Henry Springs northwest of the Henry Mine. This suggests that current Wells Formation monitoring wells are ideally located to detect any impacts to the Wells Formation from backfilled mine pits or other sources. Continued monitoring of the monitoring wells on either side of the Little Blackfoot River is needed to help assess any potential effect a possible structure in this area may be having on groundwater flow.

Enoch Valley Mine

In general, alluvial groundwater at the Enoch Valley mine has been characterized with the exception of two localized areas where impacts at or below the Idaho groundwater standard of 0.05 mg/L have been identified. The source from the selenium measured at BH106 (Drawing 10) may be local runoff from the active operations. This source will be addressed when these operations are closed. However, soil samples will be collected in the area of the active operation in 2009 as part of the soil and vegetation sampling program, and visual observations will be made as to potential sources. This information will be used to further assess the need for more immediate follow up in this area. The source of measured selenium in BH083 and MMW013 is likely the same as that for the Dinwoody Formation, and is a remaining data gap to be addressed.

The detection of levels of selenium near or above the Idaho groundwater rule in the intermediate Dinwoody Formation groundwater system at the Enoch Valley Mine suggests the need for some additional characterization. In the northwestern portion of the mine the Dinwoody Formation appears to be functioning as the uppermost water bearing zone and impacts to this system may be more typical of a local alluvial system. Additional monitoring wells to address the vertical or horizontal extent will be needed to characterize the significance of this flowpath. This condition is also present in the southeast half of the mine area at MMW024 (Drawing 26), although COPC concentrations are generally lower. Some additional characterization in this area is also warranted.

Concentrations of selenium in the Wells Formation in the Enoch Valley Mine are relatively low and do not suggest a significant flowpath for selenium and other COPCs for mine sources (primarily backfilled mine pits). At this time flow along strike both to the northwest and southeast is monitored. Because of the depth to reach the downdip groundwater, no characterization has been recommended or conducted southwest of the mine. Ongoing monitoring of COPC concentrations and piezometric conditions will <u>help</u> complete the characterization.

3.3 Preliminary Identification of 2009 Field Activities

Possible additional characterization field activities to address remaining data gaps are presented below. Once the A/T have reviewed this DSR and an agreement is reached with P4 on the remaining data gaps and actions to address these gaps, an addendum to the existing SAPs will be developed to implement the 2009 hydrogeologic field activities. Given the presentation of data and limited analysis in this DSR, the following additional field activities should be considered.

3.3.1 Alluvial Groundwater System Follow-up Direct-Push Sampling Program and Well Installation

As indicated on Drawing 28, the plume on the western side of the Ballard Mine is not defined in the western and southwestern directions. It is estimated that 5 to 10 direct-push sampling points will be needed to complete the definition of the western plume. In addition, at least two additional long-term monitoring wells will need to be installed to monitor the downgradient edge of the plume. Monitoring wells are currently installed in the core of the plume that allows monitoring of concentrations in the upgradient portions of the plume. The plume on the northwestern area of the Ballard Mine is largely characterized; however, it also will likely require three to five additional direct-push sampling points to complete the characterization.

As indicated on Drawing 27, the selenium plumes on the eastern side of the Ballard Mine appear nearly defined. Approximately four additional direct-push holes are expected to be needed to complete this characterization, as well as up to two long-term direct-push monitoring wells.

It is recommended that two to four direct-push boreholes be attempted in the area between the Little Blackfoot River and waste rock dump MWD088 at the Henry Mine (Drawing 8). At least one direct-push monitoring well should be installed in this area to monitor long-term trends in this alluvial system. Similarly, two to four additional direct-push boreholes should be advanced between MMW013 and the direct-push borehole BH085 to add definition to the selenium concentrations detected in the alluvial system in the southern portion of the Enoch Valley Mine (Drawing 9).

3.3.2 Intermediate Groundwater System Well Installation

Dinwoody Formation monitoring well MMW029 at the Ballard Mine and MMW027 at the Enoch Valley Mine indicate that the Dinwoody Formation is capable of transporting COPCs (primarily selenium) derived from waste rock sources at concentrations above regulatory limits. To further characterize this pathway and the nature and extent of elevated selenium (and other COPC concentrations) in the Dinwoody Formation groundwater system, additional monitoring wells will be required. Data from these wells will be needed to address the vertical and horizontal extent of elevated COPCs.

These additional wells may include a deeper monitoring wells paired with MMW029 and a deeper well near MWD084 at the Ballard Mine, and deeper wells paired with MMW013 and MMW027 at the Enoch Valley Mine. In addition, at least one additional monitoring well should be installed in a probable downgradient direction from MMW027.

3.3.3 Regional Groundwater System Monitoring

Many data gaps associated with the regional Wells Formation have been resolved. However, ongoing monitoring of COPC concentrations and piezometric conditions in the monitoring wells is needed to help complete the characterization.

3.3.4 Surface Water Quality Sampling and Monitoring

It is proposed that surface water quality sampling will be continued in 2009 but on a more limited basis. The rationale for sampling, locations and analytes will be presented in a pending surface water quality monitoring sampling and analysis plan to be presented to the A/T in March 2009.

3.3.5 Data Collection for the Mine Areas Water Balance

To refine the water balance for the mine areas, a refined estimate of the waste rock water balance, precipitation, runoff, infiltration, evapotranspiration, and deep percolation is needed. It is recommended that an unsaturated flow model be used to conduct this assessment. This is a more accepted approach for waste rock facilities over the more simplistic HELP model. Use of the more sophisticated model will be justified if more complete characterization data are available. The following tests are recommended to provide additional input to refine this model:

- Collection and grain size analysis of 10 - 12 samples from each of the three mine areas distributed among the various cover soil types identified during the 2009 soil and vegetation sampling program.

- Several hand auger borings at each waste rock dump to test the thickness of the soil covers where present and not well defined by previous data.

- Six to 12 in-situ tests of the cover soils with a Guelph permeameter to estimate the vertical hydraulic conductivities for each waste rock dump (Soilmoisture Equipment Corp, 2006; Meiers, et al., 2006; ASTM, 1998 [Air-Entry Permeameter]; Dolezal, et al., 1997).

Complete current topographic data is now available, as of late 2008, to assist in determining average slope angles and runoff areas. The 2009 soil and vegetation sampling program will provide improved data for assessment of the vegetation cover and thereby evapotranspiration. In addition, once reported, detailed data for the Enoch Valley Mine waste rock facilities from an ongoing study currently being sponsored by the Idaho Mining Association can be incorporated, as well as studies being conducted for the permitting of the planned Blackfoot Bridge Mine.

TABLE 3-1
DATA GAP MATRIX FOR THE BALLARD MINE

Conceptual Flowpath	Source Type	Location/ Potential Sources	Completed Flowpath (1)	Wells in Flowpath	Other Existing Data	Diagrams Illustrating Conceptual Model	Data Gap	Proposed Action to Address Data Gap	Note or Comment
Local – Alluvial/Colluvial	Waste Dump	Eastern Mine Area MWD084 MWD082	Yes	Monitoring Wells MMW018 (0.027mg/L T-Se, both Spring and Fall 2008) Direct-Push Wells MBW032 (0.63 mg/L D-Se) MBW048 (<0.001 mg/L D-Se) Concentrations from Spring 2008 boreholes samples.	Springs (and other expressions o f groundwater) MST093 (<0.001 mg/L T-Se) MST094 (<0.001 mg/L T-Se) MST095 (0.23 mg/L T-Se) MST096 (0.031 & 0.030 mg/L T-Se) MSG004 (0.005 & 0.014 mg/L T-Se) MSG005 (0.015 & 0.0048 mg/L T-Se) MSG006 (0.098 & 0.023 mg/L T-Se) MSG007 (0.02 & 0.013 mg/L T-Se) Spring and Fall 2008 events, Several stations dry in the Fall. Direct Push Points Area E (<0.001 -1.25 mg/L Se, see Drawing 27)	Sections S, Drawing 17 and Ballard Geology Map Drawing 13 - *also see Sections C and T (Drawings 12 and 15) in MWH 2008c.*	Extent of selenium impacts above drinking water standard in alluvial system is substantially defined by direct-push program. Requires some additional closure of plume boundaries (see Drawing 27)	Area coverage to be expanded and increased in resolution in proposed Spring 2009 Direct-Push Sampling Investigation. Installation of additional long-term monitoring locations for temporal trend evaluation. Specifically, additional direct-push boreholes will be placed to better delineate the plume originating from the area of MWD084 between stream station MST093 and BH050, and along the downgradient edge of the plume originating from the MWD082 area.	
		Western Mine Area MWD083 MWD081 MWD080	Yes	Monitoring Wells MW-15A (1.1 - 1.4 mg/L T-Se) MW-16A (0.070 – 0.16 mg/L T-Se) MMW017 (0.10 mg/L T-Se, both Spring and Fall 2008) Direct-Push Wells MBW006 (0.34 mg/L D-Se) MBW009 (0.026 mg/L D-Se) MBW011 (0.16 mg/L D-Se) MBW013 (1.7 mg/L D-Se) MBW026 (0.2 mg/L D-Se) MBW027	Springs (and other expressions o f groundwater) MST067 (0.41 mg/L T-Se) MST068 (0.48 mg /L T-Se) MST069 (0.87 & 1.2 mg/L T-Se) MST278 (Dry) MSG008 (0.34 mg/L T-Se) Spring and Fall 2008 events, MST067 and MSG008 were dry in the Fall. Direct-Push Points Area F (<0.001 -1.68 mg/L Se), and Area G	Sections H, R and U (Drawings 15, 16 and 18) and Ballard Geology Map (Drawing 13) *- also see Sections C (Drawings 12) in MWH 2008c.*	Extent of selenium impacts above drinking water standard in alluvial system is substantially defined by direct-push program. Requires some additional closure of plume boundaries (see Drawing 28).	Area coverage to be expanded and increased in resolution during proposed Spring 2009 Direct-Push Sampling Investigation. The installation of additional long-term monitoring locations for temporal trend evaluation will be completed. Specifically, boreholes will be added along the western side of the plumes originating and the area of MWD080 and MWD081 and along edge of the plume near the Blackfoot River.	

TABLE 3-1
DATA GAP MATRIX FOR THE BALLARD MINE

Conceptual Flowpath	Source Type	Location/ Potential Sources	Completed Flowpath (1)	Wells in Flowpath	Other Existing Data	Diagrams Illustrating Conceptual Model	Data Gap	Proposed Action to Address Data Gap	Note or Comment
				(0.016 mg/L D-Se) MBW028 (0.62 mg/L D-Se) Concentrations from boreholes samples.	(<0.001 -1.32 mg/L Se), see drawing 28				
		Central Mine Area MWD093 MMP036	No	None	Springs MDS030 (0.42 & 0.89 mg/L T-Se) MDS031 (0.66 & 0.73 mg/L T-Se) MDS032 (0.45 mg/L T-Se) MDS033 (0.75 mg/L T-Se) MSG003 (0.37 & 0.64 mg/L T-Se) Spring and Fall 2008 events, Several stations dry in the Fall.	Section H (Drawing 15) *and in MWH (2008c), Sections C and Q (Drawings 12 and 14)*	None - Not a completed flowpath.	None	No action in 2008 other than continued sampling of springs as part of the ongoing monitoring program. Flow is primarily colluvial if present. Flowpath is intercepted by West Ballard Pit
	Open Mine Pit	MMP035, MMP039, MMP040, MMP037	No	---	---	*Same as above*	None - Not a completed flowpath.	None	No action in 2008. There is no potential for direct discharge from pits to alluvium or colluvium (i.e., pits are a hydraulic sink below level of alluvium)
	Backfilled Mine Pit	None	No	---	---	---	None - Not a completed flowpath.	None	No action in 2008. There are no backfilled mine pits at Ballard to the level of the alluvial or colluvial deposits in the area.
Intermediate – Dinwoody / Thaynes Formations	Waste Dump	Eastern Mine Area MWD084 MWD082	Yes	Monitoring Wells MMW018 (0.027 mg/L T-Se both Spring and Fall 2008 on top of Dinwoody Fm.) MMW029 (0.81 mg/L T-Se, Fall 2008)	None	Section S (Drawing 17) and Ballard geologic map (Drawing 13), and in *MWH (2008c), Sections C and T (Drawings 12 and 15)*	Possible impacts to Dinwoody Fm. from impacted alluvium or waste rock directly on Dinwoody Fm. has been indicated. Vertical and horizontal nature and extent are not well defined.	Deeper nested well to assess vertical extent and hydraulic gradients near MWD082 located near MMW029 and MBW032. Deeper well in area of MWD084 to assess deeper flowpath (may be Dinwoody Fm., or deeper alluvium).	Minimal direct contract between the waste rock deposits and the Dinwoody Formation in this area except at MWD082. Affected groundwater is present in shallower Dinwoody Formation.
		Western Mine Area MWD083 MWD081	No	None – Dinwoody Fm. not present in any boring.	None	Sections H, R and U (Drawings 15, 16 and 18) and Ballard Geology Map (Drawing 13), *In MWH (2008c), Sections C and I.*	None - Not a completed flowpath	None	No action in 2008. Dinwoody Formation not located in this area. Wells installed west of the mine have encountered Wells Formation.

TABLE 3-1 DATA GAP MATRIX FOR THE BALLARD MINE									
Conceptual Flowpath	**Source Type**	**Location/ Potential Sources**	**Completed Flowpath (1)**	**Wells in Flowpath**	**Other Existing Data**	**Diagrams Illustrating Conceptual Model**	**Data Gap**	**Proposed Action to Address Data Gap**	**Note or Comment**
		Core Mine Area MWD093 MMP036	Possible but not significant	Monitoring wells MMW030, MW-16A and MBW006 are located downgradient of possible discharge area; however, any impacts cannot be distinguished from impacts from MWD081.	Springs MDS030 (0.42 & 0.89 mg/L T-Se) MDS031 (0.66 & 0.73 mg/L T-Se) MDS032 (0.45 mg/L T-Se) MDS033 (0.75 mg/L T-Se) MSG003 (0.37 & 0.64 mg/L T-Se) Spring and Fall 2008 events, Several stations dry in the Fall. Direct-push Boreholes Alluvium closest to possible pathway was dry.	Section H and U (Drawings 15 and 18) and Ballard Geology Map (Drawing 13)	General discharge is to interior mine areas; however, some flow through the Dinwoody Formation to the drainage south of MMP035 is possible. Geology would direct this flow to either the alluvial system or Wells Formation. However, the alluvium in the area was dry, probably downgradient bedrock monitoring well (Wells Fm.) contained less than 0.001 mg/L T-Se (<0.0010).	None	No action in 2008 The potential loading to the external area of the mine is expected to be small and loading from MWD081 will mask any contribution from interior mine area.
	Open Mine Pit	MMP035 MMP036 MMP037 MMP039 MMP040	No	None	None	See Sections H and R (Drawings 15 and 16) for examples.	None - Not a completed flowpath	None	No action in 2008. Incomplete pathway because water from mine pits cannot discharge directly to the Dinwoody Fm. The one exception to this, MMP040, is located in the interior of the site and any impacted water will discharge to the west pit (MMP035).
	Backfilled Mine Pit	None	No	None	None	----	None - Not a completed flowpath, only minor areas of pit backfill.	None	No action in 2008.
Regional – Wells Formation	Waste Dump	Eastern Mine Area MWD082 MWD084	Possible	None	Direct-push sampling program to define selenium concentrations in the overlying alluvium (see Drawing 27).	See Geology Map (Drawing 13)	Impacted groundwater flow in the alluvium could cross the trace of the Slug Valley Fault and infiltrate into the underlying Wells Formation. Direct-push sampling has indicated that a selenium plume has extended out into the area; however, concentrations are relatively low, and therefore, deep penentration into the Wells Formation is not expected, nor has it been observed to occur in the western portion of the mine.	None	Groundwater flow in the Wells Fm. in this area is thought to be from the recharge area towards the site. Selenium concentrations in the alluvium east of the assumed trace of the Slug Valley Fault are near or below the 0.05 mg/L groundwater standard.
		Western Mine Area MWD080 MWD081 MWD083 MWD093	No	Monitoring Wells MM-15A (1.1 & 1.4 mg/L T-Se) MW-16A (0.070 & 0.016 mg/L T-Se)	Ponds MSP062 (<0.0010 mg/L T-Se [2004]) Pond in Middle Ballard Mine Pit	Sections H, R and U (Drawings 15, 16 and 18)	Impacts due to alluvium impacted from waste rock seepage to Wells Fm. are not apparent.	None.	Compartmentalization may be limiting impacts to the Wells Formation. Long-term potentiometric monitoring will help define the hydraulic isolation of

TABLE 3-1 DATA GAP MATRIX FOR THE BALLARD MINE									
Conceptual Flowpath	**Source Type**	**Location/ Potential Sources**	**Completed Flowpath (1)**	**Wells in Flowpath**	**Other Existing Data**	**Diagrams Illustrating Conceptual Model**	**Data Gap**	**Proposed Action to Address Data Gap**	**Note or Comment**
				MMW017 (0.10 mg/L T-Se, Spring and Fall 2008) indicate shallow impact ; MMW030 (<0.0001 mg/L T-Se MMW031 (0.00087 mg/L T-Se), Fall 2008					individual areas. Monitoring wells installed in the Wells Formation in areas of impacted alluvium have had relatively low concentrations of selenium.
	Open Mine Pit	Eastern and Central Mine Area MMP037 MMP039 MMP040	No	None	None	*See Section C (Drawing 12) MWH (2008c)*	None	None	No action in 2008. Flow projected to be east to west. Impacts to Wells Fm. east of the mine appear unlikely.
		Western Mine Area MMP035 MMP036 MMP038	Yes	<u>Monitoring Wells</u> MMW020 (0.010 & 0.0088 mg/L), MMW021 (0.049 & 0.050 mg/L), MMW006 (0.069 & 0.071 mg/L), Spring and Fall 2008, respectively; MMW030 (<0.00010 mg/L T-Se MMW031 (0.00087 mg/L T-Se), Fall 2008	None	Sections H, R and U (Drawings 15, 16 and 18)	Impacts to Wells Fm. are possible due to impacts indicated in the mine area. However, impacts to Wells Formation northwest and southwest of the mine are not indicated.	None	Impacts are probably not a direct result of the mine pits, but the mine pit may act as a conduit to the Wells Formation for water seeping from waste rock. Flow will be directed by the bedding strike which is predominantly to the northwest.
	Backfilled Mine Pit	All	No	None	None	---	None - Not a completed flowpath	None	No action in 2008. Backfill mine pit are not a significant feature of the Ballard Mine area.
Structurally Controlled Flow	All	All	Yes	<u>Monitoring Wells</u> MMW020 (0.010 & 0.0088 mg/L), MMW021 (0.049 & 0.050 mg/L), MMW006 (0.069 & 0.073 mg/L), Spring and Fall 2008, respectively; MMW030 (<0.00010 mg/L T-Se MMW031 (0.00087 mg/L T-Se), Fall 2008	None	Illustrated on most Ballard sections.	It is also possible that some structures (e.g., along the south edge of the mine area) could result in impacted groundwater flow to the Wells Fm. However, MMW030 is unaffected and is in the best position to identify an impact to this pathway.	Potentiometric monitoring	Alternatively, the faults may act as flow barriers compartmentalizing the Wells Formation. At this time data suggest this is occurring. Longer term piezometric data will be needed to confirm this.

Notes:
Monitoring and seep and spring data are from the Spring and Fall 2008 sampling events, except for new 2008 well that were only sampled in the Fall 2008 event, and as otherwise noted.
T-Se = Total selenium, D-Se = Dissolved selenium
(1) Are there indications that groundwater flow is occurring from potential source areas and that COPC transport is occurring? (Yes/No)

TABLE 3-2 DATA GAP MATRIX FOR THE HENRY MINE									
Conceptual Flowpath	**Source Type**	**Location/ Potential Sources**	**Completed Flowpath[(1)]**	**Monitoring Wells in Flowpath**	**Other Existing Data**	**Diagrams Illustrating Conceptual Model**	**Data Gap**	**Action to Address Data Gap**	**Note or Comment**
Local – Alluvial (Basalt)	Waste Dump	Northeast side of Henry Mine	Yes	MMW019 0.0040 & 0.00056 mg/L T-Se), MMW010 (0.10 & 0.018 mg/L, <0.001 mg/L T-Se in Fall 2007), MMW014 (<0.001 – 0.002 mg/L T-Se) Data from Fall 2007 and Spring and Fall 2008 sampling.	Shallow basalt wells MMW003 (no 2008 data) & MMW004 (0.002 & 0.0025 mg/L T-Se) MSG002 (Dry & 0.016 mg/L T-Se) MSG022 (<0.001 & 0.0043 mg/L T-Se) MSG016 9Dry) MST276 (0.005 & 0.0035 mg/L T-Se) <u>Direct-Push Points</u> Area C (<0.001 - 0.031 mg/L D-Se) Area D (<0.001 - 0.13 mg/L D-Se)	Sections O and V (Drawings 19 & 20)	Extent of impacts to shallow alluvium not well understood in a small alluvial area north of waste rock dump MWD088. Impacts to all other areas appear confined to waste rock footprint areas and are characterized by relatively low Se concentrations.	Four to six additional direct-push sampling points as part of a 2009 direct-push sampling program in the area north of MWD088.	
		Valley fill portion of MWD087 (in Long Valley drainage)	Yes	None	Direct-push borehole BH072 (see Drawing 8) MST277 (<0.001 mg/L T-Se in spring)	Drawing 14	None	None	Direct-push sampling was conducted in this area, and alluvial groundwater was not present in this area.
		Alluvium NW of MWD085/MMP041	No	None	None	Drawing 14	None	None	No action in 2008. Waste rock does not overlay the alluvial system in the area.
	Open Mine Pit	MMP041 and MMP044 (unbackfilled portions)	No	NA	None	*Section P (Drawing 18 in MWH, 2008c)*	None	None	No action in 2008. There is not a direct flowpath between the open mine pits and the alluvial system.
	Backfilled Mine Pit	MMP041 through MMP044	Yes (one location)	None	<u>Direct-Push Points</u> BH079 (<0.001 mg/L D-Se), BH072 & 078 (dry)	Drawing 14	None	None	Direct-push sampling was conducted in the drainage downgradient of the location, selenium was not detected or alluvium was dry.
Intermediate – Dinwoody / Thaynes Formations	Waste Dump	NE side of Henry Mine MWD086	Yes, Dinwoody Only	MMW022 (0.017 & 0.018 mg/L T-Se, Spring and Fall 2008) MMW028 (0.0026 mg/L T-Se, Fall 2008)	Spring survey (none found)	Section V (Drawing 20) *Section B (Drawing 16) in MWH, 2008c*	None	None	Only slight impacts in the Dinwoody Formation identified in "worst case" locations
	Open Mine Pit	NA	No	NA	None	NA	None	None	Dinwoody Formation is not exposed in the open pits.
	Backfilled Mine Pit	NA	No	NA	None	Sections B and E (Drawings 16 and 19)	None	None	Dinwoody Formation is not exposed in the open pits.
Regional – Wells Formation	Waste Dump	Valley fill portion of MWD087	Possibly	None	None	Drawing 14	If alluvium is impacted this could be a source to the Wells	None	Configuration of this waste dump is very favorable for

TABLE 3-2 DATA GAP MATRIX FOR THE HENRY MINE									
Conceptual Flowpath	**Source Type**	**Location/ Potential Sources**	**Completed Flowpath[(1)]**	**Monitoring Wells in Flowpath**	**Other Existing Data**	**Diagrams Illustrating Conceptual Model**	**Data Gap**	**Action to Address Data Gap**	**Note or Comment**
							Formation – alluvium was generally dry		limiting infiltration. An impact seems unlikely.
	Open Mine Pit	South & North Henry Pits (MMP041 and MMP044)	Yes	MMW023 (0.0040 & 0.0039 mg/L, Spring and Fall 2008)	None	*Section P (Drawing 18) in MWH, 2008c*	None	None	A significant impact is not apparent based on the data from MMW023, which was installed directly in the base of MMP041. Pathway does not appear significant.
	Backfilled Mine Pit	MMP041 through MMP044	Yes	MMW011 (<0.0010 & 0.00088 mg/L) (laterally placed along strike), MMW023 (0.0040 & 0.0039 mg/L T-Se, Spring and Fall 2008)	None	*Section B and N (Drawings 16 and 17) in MWH 2008c*	None	None	Flow in Wells Formation should be directed toward Henry springs along the strike of the formation. MMW011 and MMW023 are ideally located for monitoring this flowpath. 2008 potentiometric data support the NW gradient.
Structurally Controlled Flow	All	Between MWD085 & MMP043 along Little Blackfoot River	No	MMW004 (0.0020 & 0.0025 mg/L T-Se), MMW011 (<0.0010 & 0.0009 mg/L T-Se), MMW019 (0.0040 & 0.00056 mg/L T-Se) Spring and Fall 2008	None	NA	Potential flowpath not characterized. However, there is not a direct source. Other impacted media would be required as a secondary source.	None	This is a secondary flowpath as there is not direct contact with waste.
		South of Henry Mine and MMP044	No	None	None	NA	Fault not characterized; however conceptually it is not a flowpath.	None	Flow in the Wells Formation should be to the northwest and the thrust fault is most likely a flow barrier.
		Primarily backfilled mine pits as a potential source to the regional flow system	No	Water level data from MMW011 and MMW023 will be key in assessing the flowpath	Data collection is ongoing	NA	Cross-cutting structures may divert flow along the strike of the Wells Formation and wells located on the north end of the mine may not be hydraulically connected to the south end.	Monitoring of water level responses across the probable structure where the Little Blackfoot River crosses the mine.	An indication of compartmentalization may result in the need for an additional Wells Fm. well in the southern portion of the mine.

Notes:
Monitoring and seep and spring data are from the Spring and Fall 2008 sampling events, except for new 2008 well that were only sampled in the Fall 2008 event, and as otherwise noted.
T-Se = Total selenium, D-Se = Dissolved selenium
(1) Are there indications that groundwater flow is occurring from potential source areas and that COPC transport is occurring? (Yes/No)

TABLE 3-3
DATA GAP MATRIX FOR THE ENOCH VALLEY MINE

Conceptual Flowpath	Source Type	Location/ Potential Sources	Completed Flowpath[1]	Wells in Flowpath	Other Existing Data	Diagrams Illustrating Conceptual Model	Data Gap	Action to Address Data Gap	Note or Comment
Local – Alluvial	Waste Dump	Southern Mine Area - MWD092 (Stormwater ponds MSP017 through MSP021)	Yes	Monitoring Wells MMW007 (0.0050 & 0.0024 mg/L T-Se) MMW008 (<0.0010 & 0.0014 mg/L T-Se) MMW013 (0.051 & 0.091 mg/L T-Se) Other Wells (direct-push samples) MBMW085 (0.001 mg/L D-Se) MBMW087 (<0.001 mg/L D-Se) MBMW099 (<0.001 mg/L D-Se) MBMW100 (<0.001 mg/L D-Se)	Stormwater ponds and dump seeps with elevated selenium [e.g., MSD026 (0.19 &0.019 mg/L T-Se_ MST144 0.21 mg/L T-Se & dry, MST269 0.071 mg/L T-Se & dry, and MSP017(0.98 & 0.078 mg/L T-Se)] Direct-Push Points Area C (<0.001 - 0.012 mg/L D-Se)	Sections J, K and L (Drawings 21 - 23), Geologic Map (Drawing 14)	Data gap has largely been addressed.	A few direct-push holes near MMW013 to further define extent.	Alluvial groundwater off of the southwest end mine area has low selenium concentrations, generally less than 0.001 mg/L. However, there are some concentrations approaching or exceeding 0.05 mg/L near MMW013.
		Northern Mine Area - MWD091	Yes	Monitoring Wells MMW012 (dry) Other Wells (Spring 2008 data) MAW001 (0.002 mg/L T-Se), MAW002 (0.002 mg/L T-Se), MAW003 (0.002 mg/L T-Se), MDW001 (<0.001 mg/L T-Se), and MDW002 (<0.001 mg/L T-Se) these wells may not draw exclusively from alluvium. Other Wells MBMW107 (0.001 mg/L D-Se) MBMW112 (Dry)	Springs MST059, 60 & 61 (dry) MSG001 (0.002 & 0.024 mg/L T-Se) Direct-Push Points Area D (<0.001 - 0.001 mg/L D-Se)	Section L (Drawing 23)	Extent not completely defined.	Further investigation of the underlying Dinwoody Formation groundwater system.	Alluvial groundwater is generally not present, but where sampled has been at or less than 0.001 mg/L Se.
	Open Mine Pit	None	No	---	---	Same as above.	None	None	There is no potential for discharge from pits to alluvium (i.e., pits are a hydraulic sink below level of alluvium)
	Backfilled Mine Pit	None	No	---	---	Same as above	None	None	There is no potential for discharge from pits to alluvium (i.e., pits are a hydraulic sink below level of alluvium)
Intermediate – Dinwoody / Thaynes	Waste Dump	Southern Mine Area, west of	Yes	Monitoring Wells MMW013 (0.051 &	None directly related to	Section K (Drawing 22)	Nature and extent near MMW024 has not been	Possible well location nested with MMW013.	

TABLE 3-3 DATA GAP MATRIX FOR THE ENOCH VALLEY MINE									
Conceptual Flowpath	**Source Type**	**Location/ Potential Sources**	**Completed Flowpath[1]**	**Wells in Flowpath**	**Other Existing Data**	**Diagrams Illustrating Conceptual Model**	**Data Gap**	**Action to Address Data Gap**	**Note or Comment**
Formations		MWD092, near MDS025		0.091 mg/L T-Se) MMW024 (0.014 mg/L T-Se) MMW030 (<0.0001 mg/L T-Se)	Dinwoody Fm.		completely defined.		
		Central Mine Area near MPW020 (central portion of MWD091 pit backfill)	No	None	---	*Section A (Drawing 20) in MWH, 2008c*	None	None	No or very minor source to Dinwoody Fm. at this location. Not considered a completed flowpath.
		Northern Mine Area west of MWD091 near MMW012	Yes	Monitoring Wells MMW012, but in alluvium MMW027 (0.31 mg/L T-Se)Other Wells MAW001, MAW002, MAW003, MDW001, and MDW002 all had T-Se 0.002 mg/L or less. May not draw in part from the Dinwoody or Thaynes.	Springs MST059, MST060 and MST061 but flow from these locations has never been identified or sampled.	Sections L and M (Drawing 23 and 24)	Nature and extent of COPCs in Dinwoody flow system near MMW027 has not been completely defined.	Additional monitoring wells are needed in the area of MMW027 to complete characterization. One monitoring well may be nested with MMW027 and a second one installed in the potential downgradient direction.	The Dinwoody Formation appears to represent the uppermost groundwater system in this area.
		Near MMW007	Yes	Monitoring Wells MMW007 (0.0050 & 0.0024 T-Se mg/L), MMW008 (<0.0010 & 0.0014 T-Se mg/L), and MMW025 (0.00088 mg/L T-Se)	None directly related to Dinwoody Fm.	Sections D and J (Drawing 21)	None	None.	Shallow Dinwoody Fm. not impacted.
	Open Mine Pit	Central Mine Area MMP045	No	---	---	*Section A (Drawing 20) in MWH, 2008c*	None	None	At Enoch Valley the Dinwoody Fm. is not exposed in the mine pits such that it completes a flowpath for this type of facility.
	Backfilled Mine Pit	Northern and southern mine areas – pits MMP045, with MWD091 backfill.	No	---	---	Sections K and L (Drawings 22 and 23)	None	None	At Enoch Valley the Dinwoody Fm. is not exposed in the mine pits such that it completes a flowpath for this type of facility.
Regional – Wells Formation	Waste Dump	None	No	None	None	Sections K and L (Drawing 22 and 23)	None	None	Waste dumps are generally not a direct source to the Wells Fm. All outcrops of the Wells Fm. are to the east.
	Open Mine Pit	MMP045	Yes	Other Well MPW020 screened in Rex Chert down-dip of mine pit contains no detectable T-Se	None	*Section A (Drawing 20), MWH 2008c*	None	None	Monitoring well installation technically challenging in this area. Impacts to the Wells Formation in other more susceptible areas have not been identified.
	Backfilled Mine Pit	MMP045	Yes	Monitoring Well MMW009 (<0.001	None	Sections K and L (Drawings 22 and 23)	None	None	Groundwater flow to the northwest or southeast in the Wells Fm. is

TABLE 3-3 DATA GAP MATRIX FOR THE ENOCH VALLEY MINE									
Conceptual Flowpath	**Source Type**	**Location/ Potential Sources**	**Completed Flowpath[(1)]**	**Wells in Flowpath**	**Other Existing Data**	**Diagrams Illustrating Conceptual Model**	**Data Gap**	**Action to Address Data Gap**	**Note or Comment**
				& 0.0011 mg/L T-Se) MMW026 (0.0013 mg/L T-Se) <u>Other Wells</u> potentially MPW006 and MAW005 (both <0.001 mg/L T-Se)					more likely to reach receptors and can be investigated without excessive well drilling. Concentration in these locations continue to be well below groundwater standards.
Structurally Controlled Flow	Waste Dump and associated backfilled mine pit.	MWD091, MMP045	Unknown	None	None	None	None	None	Field evaluation of area is of limited value, but P4 pit geology indicates a fault is present. However, testing of the deep flowpaths in the Wells Formation, notably MMW009, suggests that deep flowpaths are probably not significant COPC transport pathways.
Notes: Monitoring and seep and spring data are from the Spring and Fall 2008 sampling events, except for new 2008 well that were only sampled in the Fall 2008 event, and as otherwise noted. T-Se = Total selenium, D-Se = Dissolved selenium (1) Are there indications that groundwater flow is occurring from potential source areas and that COPC transport is occurring? (Yes/No)									

4.0 CONCLUSIONS

This DSR has presented data collected in 2008, and in some cases 2007, during both field and office activities, to address identified data gaps as well as general site characterization. The data and information presented in this DSR will eventually be combined with other site characterization data to complete the evaluation of conceptual models, source areas, pathways, and receptors in the SI Report.

As a result of the hydrogeologic characterization programs conducted in 2007 and 2008, a more complete understanding of the nature and extent of selenium and other associated COPC impacts in the groundwater systems has been developed. This characterization focused on understanding and validating types of groundwater flow pathways that are transporting COPCs. Impacts to groundwater systems have been indicated at the P4 mine sites, and future work will focus on completing the characterization of relevant groundwater pathways.

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DRAWINGS